PUBLIC WORKS

Oct. 1951

CITY, COUNTY AND STATE

ewage Treatment for the Nation's Needs: Six Outstanding Articles

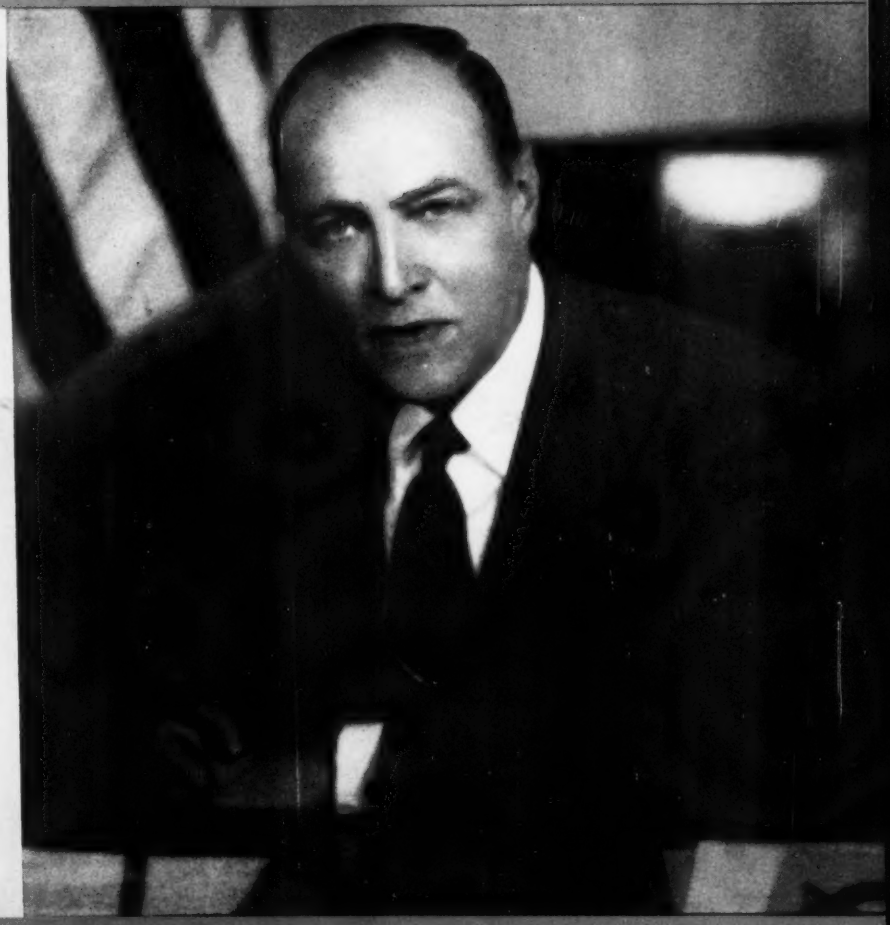
sphalt Resurfacing in New York City

ood Public Relations Help Fluoridation

ow Sheds Protect Cascade Mountain Road

lving Water Works Problems: Eight "shorts"

reet Resurfacing with Oil Mat



Frederick H. Zarnahlen, Commissioner of Public Works of New York City, has headed that city's big sewage treatment program. More data on page 30.

Some of the Jobs HUBER MAINTAINERS Are Doing

NATIONAL GOVERNMENTS

Grading and maintenance work on highways and secondary roads in national parks, reservations, national public lands.

STATES

Highway grading and maintenance service of many kinds including berm grading, mowing, ditch cleaning, etc.

COUNTIES

Highway and secondary road grading and maintenance work. Counties owning attachments keep HUBERS busy every month of the year.

MUNICIPALITIES

Street and alley grading and maintenance; every type of maintainer attachment is in municipal service.

TOWNSHIPS

Townships charged with road maintenance are among favorite users of Huber Maintainers for grader and maintenance work.

PUBLIC GROUNDS

Parks, playgrounds, conservation areas, publicly-owned beach areas need and use HUBERS for grader and maintenance service.

OIL FIELDS

HUBERS are at work in the oil fields, grading and maintaining off-the-highway roads and building dams around oil wells and storage tanks.

CEMETERIES

Cemeteries keep HUBERS busy every month, grading and maintaining drives, mowing, developing new grounds, removing snow, patching pavements, etc.

AIRPORTS

HUBERS are tailor-made for airport service, grading unpaved areas, patching paved areas, mowing, removing snow, towing planes, etc.

LOGGING

Grading and maintaining logging camp roads, mowing, bulldozer service.

INDUSTRIES

Many industrial users include factories with sizeable grounds and miles of roadways; lift loader widely used for cleanup work around factory sites.

MINES

Grading and maintenance of roadways; broom widely used around strip mines to sweep coal veins before removal.

ESTATES & RANCHES

Grading and maintenance of roadways; lift loader for cleanup; mower widely used.

RACE TRACKS

Grading and maintenance of track and of surrounding roadways and grounds.

CONTRACTORS

Contractors, large and small, in all kinds of contract work, are enthusiastic HUBER users. They like versatility of HUBERS, ability to move rapidly from one job to another.

HUBER MANUFACTURING CO. • Marion, Ohio, U. S. A.

Manufacturers of Huber Maintainers, Graders and Complete Line of Rollers

HUBER

He's Important to You

YOUR WHOLESALER

Your wholesaler is always ready with a helping hand. With a reservoir of much technical information he can supply most of the answers to your installation problems.

He can be your best friend in your community. Being on the local scene, he can appreciate your problems. Therefore, you can go to him and discuss matters with absolute confidence and mutual advantage.

He stocks nationally recognized products in as complete a supply as prevailing conditions will permit. With his broader scope of activity, he is in an excellent position to get the latest news of the industry. This affords you a good opportunity to profit from this relationship. Watching the trends and keeping abreast of developments is certainly to your interest.

Today's conditions will eventually fade away. You will again find yourself in a competitive situation where the friendly advice and cooperation of your wholesaler will be sought. Then you will consider him even more valuable. Cultivate his friendship now; it will pay good dividends. Remember too, Wolverine tube is one of the nationally recognized products he normally stocks for you.

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INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

SNOW GOUGER—T-9 pushes drifts aside with power to spare.

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PUBLIC WORKS
Magazine

Edited by W. A. Hardenbergh and A. Prescott Folwell

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CONTENTS

OCTOBER, 1951

Sewage Treatment for the Nation's Needs 53
Snow Shed Protects Cascade Highway. *By Ray Bloomberg* 54
Good Public Relations Helps the Fluoridation Program. *By E. S. Biddle* 55
Water Jetting Service Lines. *By E. D. Deeds* 56
Dry Ice Simplifies Curb Stop Replacement. *By H. M. Wooster* 56
Civil Defense Planning for the Water Department. *By Walter Turner* 57
Lowering a Water Main. *By Leroy Blocker* 57
Earth Boring by Machine for Services and Small Mains. *By W. E. Falk* 57
Fire Protection for Outlying Districts. *By John M. Walker* 57
Problems in Handling Liquid Alum. *By A. H. Labsap* 58
Corrosion in Private Water System from Electrolysis. *By W. H. Sheffield* 58
Modern Sewage Treatment for Cincinnati 58
New York's Asphalt Resurfacing Practice. *By Harry W. Levy* 59
Oil Mat Resurfacing for Improved Streets. *By J. R. Hamman* 60
Removal and Disposal of Screenings and Grit. *By S. L. Tolman* 61
Design Data and Equipment for Sedimentation. *By J. J. Gilbert* 64
What You Should Know About Sludge Digestion. *By Harry E. Schlenz* 67
Designing Activated Sludge Plants. *By Miles Lamb* 72
How to Design Trickling Filters. *By R. S. Rankin* 75
Activated Sludge for Sewage and Waste Treatment.
By A. A. Kalinske and H. W. Gillard 78
Selecting and Installing Sewage and Sludge Pumps.
By James B. Neighbor 82
Reports from the Field—Better Methods and Equipment 86
How Pest Control Operators Can Serve in Civil Defense 110
Bus and Truck Companies Approve Rock Salt Use 112

PUBLIC WORKS DIGESTS

The Water Works Digest 102
The Highway and Airport Digest 108
The Sewerage and Refuse Digest 114

PUBLIC WORKS ENGINEERING DATA

Cost of Laying Water Mains in Elmira, N. Y. 36
Cost of Laying Water Mains in Augusta, Me. 36
Bid Prices on Large Sewers 36
"Joining" Fee for Areas Annexed to City 107
Settling Tank Performance 107
Special Street Cleaning Tax 112
Sewage Plant for a Metropolitan Area 113
Radioactivity Gauge for Snowfall 118
Low-Cost Kitchen-Bath Unit. *By D. S. Abell* 127
City Supplies Garbage Cans 129
Velocity Constant Determination 129

DEPARTMENTS AND SECTIONS

The Editor's Page 6
Letters to the Editor 26
Books in Brief 28
Worth Telling. *By Arthur K. Akers* 138
Leaders in Public Works 30
Public Works Equipment 123
The Engineers' Library 132

THE ENGINEERING AUTHORITY IN THE CITY-COUNTY FIELD

THE EDITOR'S PAGE

Progress in Waste Disposal Engineering

IN no other field of engineering, we believe, has progress been more rapid or fruitful than it has been in waste disposal. The men engaged in this field, both young and old, have never admitted that anything was impossible of achievement. In addition, there has been teamwork between the publicly employed engineers and the manufacturers of equipment for waste disposal. As a result, developments in methods have been matched by developments in equipment, with the result that real costs of both construction and operation of waste disposal plants are being reduced; and this is being accompanied by the production of better effluents.

This month the Federation of Sewage and Industrial Wastes Associations holds it annual meeting. Much of the progress that has been made in this important field of engineering stems from the wise and aggressive leadership that this association has enjoyed over the years. Our congratulations and best wishes for what has been done and for the promise of even better things to come.

Training Programs for Municipal Employees Can Save Money

ONCE more we are in a period of uncertainty and of shortage of personnel, especially technical and professional men. Replacements are hard to get and the problem of fitting them into the specialized work of the various municipal departments, whether highway, sewer, water or sanitation, is often a serious one. Service suffers and costs rise because some of the staff lack the background necessary to fit quickly into the going organization.

In such situations a training program and written standard operating practices for the jobs to be done, whether design or construction, can save time and money. If such program or standards do not now exist, they ought to be developed. Everyone who reads this is going to say: "Right now we are too busy to do anything like that. We are short-handed already." Quite so; they are probably busier than that mythical one-armed paperhanger with the itch; and they are short-handed in the bargain. But it would pay big money to detach one good man from his work to develop, first, standard operating procedures for the common jobs that need to be done and done right; and, second, to work out a training program for new employees.

We know of few—and really we can't think of any—cities that have done a good job on the training program problem; and only a very few that have done much on the standard procedure problem. Both are jobs that are needed but have never been done. There have been some specialized training programs, as for sewage plant or water works operators, but nothing in the line of a broad-gauge plan for making a man an essential and valuable part of the city service organizations.

Slow Motion on Civil Defense; Let's Speed it Up

WHILE waiting for that free government money, a lot of communities have been pulling a slow-down in civil defense. Of course, it is the fashion these days to try to get a government handout for most anything, so perhaps we are out of line on this. But the fact remains, that civil defense has been lagging. No doubt this is partly due to the lack of leadership so far exhibited by federal authorities, though we personally believe that a basically good program is in the making by the FCDA.

Civil defense, however, is but a rather high-sounding name for a program that every community ought to have anyway. Natural disasters, such as the recent floods in the Missouri Valley, occur with monotonous regularity and no community is ever prepared when such an event occurs. In every community there ought to be a disaster or emergency plan to care for disasters, large or small, that may happen. Such a plan is the nucleus for civil defense, though perhaps on a lesser scale.

For more years than he cares to remember, your editor has preached of the necessity for a reasonable degree of national defense. Perhaps we are now about to reach that state; and it is to be hoped that, in the future, we will retain some semblance of a national defense organization. Just as the nation needs national defense, so local communities need plans for local defense. They should be reasonably prepared for speedy and effective action come flood, fire, hurricane, riot, earthquake or enemy action.

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You'll say—*"Mobil-Sweeper is best,"* when you see how easily it tackles tough street sweeping assignments like deep and wide gutters—sharp curb returns—steep hills—under low-hanging trees or protrusions . . . *plus* unexcelled performance on level terrain.

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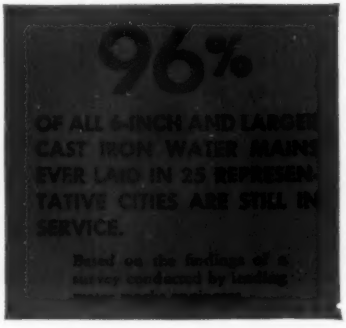

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STAMINA!*

*The Marathon race, blue-ribbon event of the modern Olympic Games (first held in Athens, Greece in 1896) was won in the record time of 2 hours 29 minutes 19.2 seconds in 1936.

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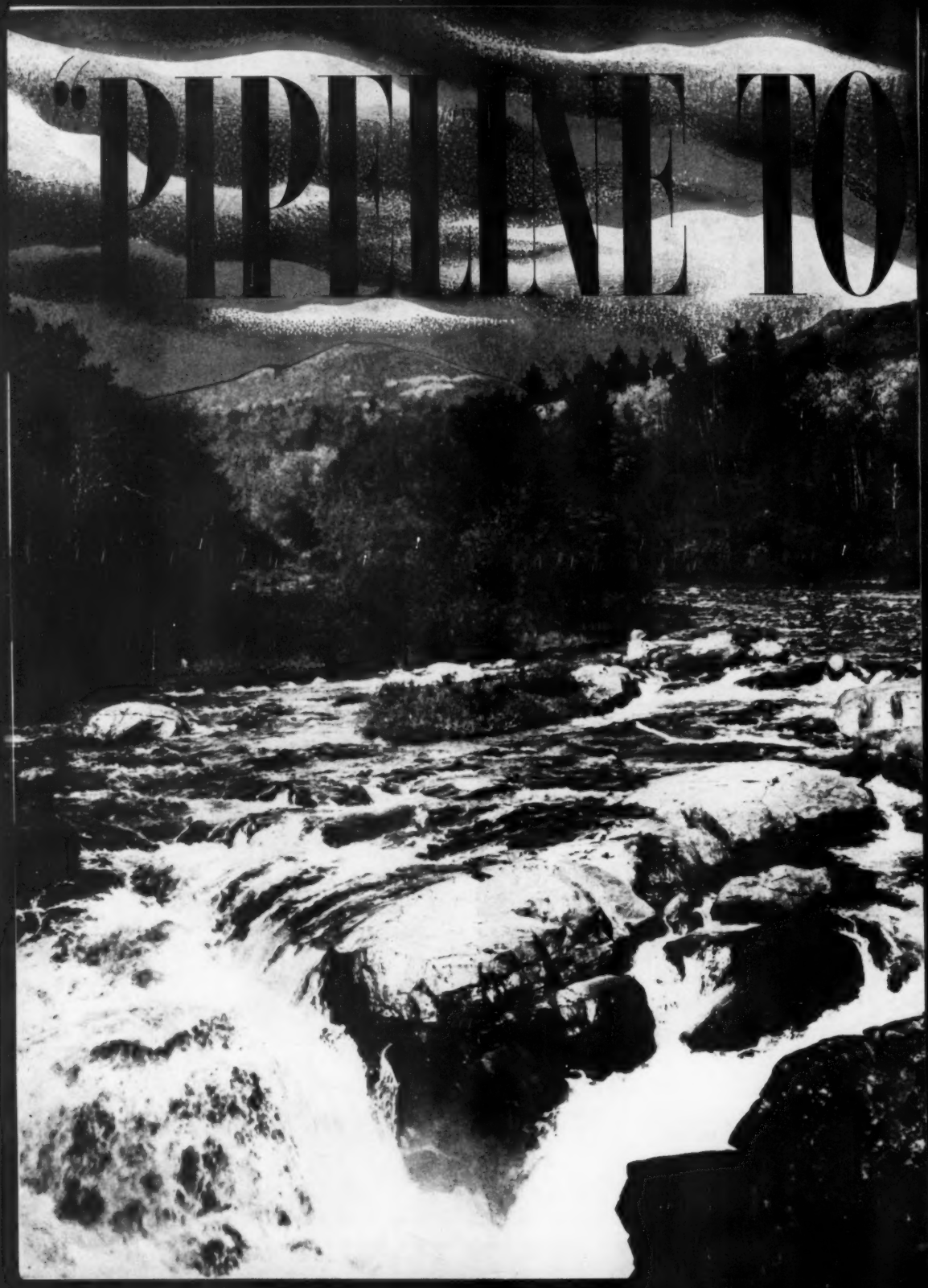
"PIPELINE TO

THE CLOUDS"

. . . a dramatic new color movie—part of a stimulating package program that dramatizes the need for an adequate water supply in your community

PLANNING—Emphasizes the importance of planning in improving water works. All community-action groups and leaders should see this film.

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- handouts highlighting important points of the film, for use at public showings.

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BEHIND-THE-SCENES—Shows the people of your community the many unseen operations necessary to assure them plenty of good, safe water.

SHORTAGE PREVENTION—Use the film to impress on civic leaders that "ten years from today is now in the water-supply business."

write today

A *free* copy of the manual, and further details about the Program, will be sent you if you request them on your letterhead. This helpful manual shows *why* you may need a new survey of your water system. It tells *how* to interpret your proposal, based on a survey, to the public. And then it describes *what* you must do, using examples from other communities, to gain public support. Write today for GEA-5555 to Sect. 666-67, General Electric Company, Schenectady, N. Y.

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GENERAL ELECTRIC

666-67

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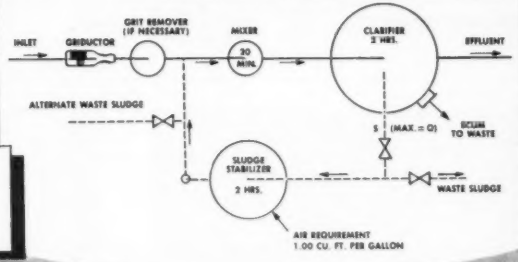
Infilco's Biosorption Process

Write for data on Infilco's new activated sludge treatment method. Ask for Bulletin No. 6550.

Suggested flow diagram with retention based on average flow of normal strength domestic sewage



RESULTS FROM ACTUAL INSTALLATION

Sewage Treatment Plant, Austin, Texas

THREE MONTHS TEST PERIOD April May June	① B.O.D. % Reduction	② SUSPENDED SOLIDS % Reduction
Avg.	93.6	93.7
Max.	98.7	97.7
Min.	89.6	90.6
Avg.	93.6	94.0
Max.	97.7	97.5
Min.	88.0	88.9
Avg.	95.6	96.0
Max.	98.8	99.1
Min.	93.6	92.4

1 B.O.D. % Reduction

2 SUSPENDED SOLIDS % Reduction

RETENTION BASED ON AVERAGE FLOW

Mixer	31 minutes
Stabilizer	2.7 hours
Clarifier	2.4 hours

3 RETENTION

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in pilot plant studies . . . and now proved by actual installation . . . the Biosorption Process is showing phenomenal results in high-rate biological oxidation sewage treatment.

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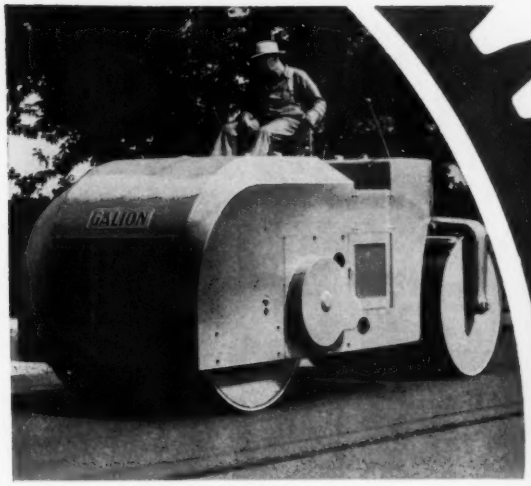

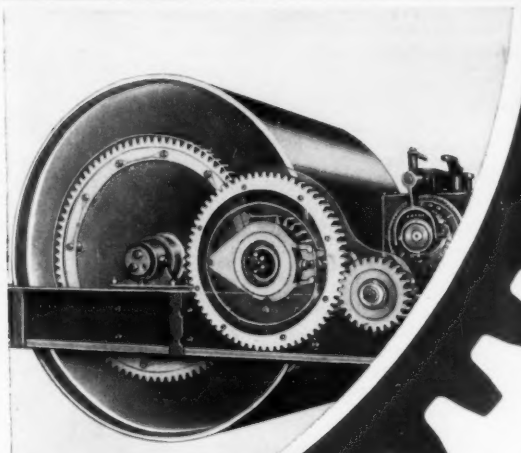

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- GALION FINAL DRIVE *greatest* gear ratio is only 5 to 1.
- GALION FINAL DRIVE spur gears are special alloy steel, accurately machine cut and heat-treated. No ordinary, uncut, cast gears are used.
- GALION FINAL DRIVE has *no small beveled pinion gear driving a large bevel ring gear* on the roll.

IF YOU KNOW YOUR GEAR MECHANICS

you know that *gradual* reduction and low speeds (each gear with roller bearings) plus a straight-line spur gear train, give the least friction and consequently have the least gear wear. That is why Galion Final Drive gears *stay in line,* wear the least, and consequently last longest without adjustment or replacement.

REMEMBER! ROLLER *RELIABILITY* – depends largely on its FINAL DRIVE mechanism

SPUR GEAR GALION FINAL DRIVE

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NO WORRY about winter storage for your **TRAXCAVATORS**—these versatile work-giants are on the job the year around.

When the snow flies, the **TRAXCAVATOR'S** sure-footed traction gets heaped bucket loads of packed snow or loose drifts . . . quickly making streets safe for traffic. **TRAXCAVATORS** efficiently convert "Caterpillar" Diesel Tractor power into digging force to break loose frozen sand, cinders and gravel for ice control.

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TRACTOR EQUIPMENT

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HERE's the situation in a nutshell. The speed, versatility and big work capacity that have made "Cat" Motor Graders so essential a year-round tool for road work have also made them essential to the armed forces. As military orders must be filled first, you may not be able to obtain prompt delivery of new machines. So it's to your advantage to plan now to get more work from your present equipment—and keep it ready for any emergency.

"Cat" Motor Graders are ruggedly built for long life. But good care on your part can lengthen that life span by thousands of extra service hours. Here's how:

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3. **Anticipate your future replacement parts needs by seeing your "Caterpillar" dealer about them *now*. Don't wait until wear gets beyond repair—many a part can be rebuilt *if* serviced in time.**

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For these CITIES

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Write to-day to arrange for a visit from your W&T Engineer or for technical bulletins on cyanide waste treatment, all at no obligation.

S-63

FOR DETAILS,
SEE YOUR W&T ENGINEER

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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

HERE'S ASPIRIN for construction headaches

Have you heard how Armco Steel Sheeting takes the headaches out of many construction and maintenance jobs?

This durable sheeting has ample strength plus light weight and a small displacement area. It can generally be driven to full penetration without excavating. Either a hand maul or power hammer does the job quickly and easily.

For utmost economy, Armco Sheeting can be used again and again. A convenient hole near the top of each section facilitates pulling. The units nest together for convenient storage.

Armco Sheeting comes in flange and interlocking types for both temporary and permanent uses. It is a work-saving, cost-cutting tool for shoring trenches; building low retaining walls and cofferdams; preventing bank erosion on streams and lakes; and many similar applications. Write for complete information. Armco Drainage & Metal Products, Inc., 3721 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

• • •

(1.) Armco Steel Sheeting protects excavation while sewer break is repaired. (2.) Driving Armco Sheeting for flood wall. (3.) Valuable shore property is restored and protected by installing Armco Steel Sheeting. (4.) A midwestern city uses Armco Sheeting as maintenance equipment.

MORE SCRAP MEANS MORE STEEL . . . TURN YOURS IN TODAY!

ARMCO STEEL SHEETING

ARMCO

Thousands use our Readers' Service card to keep up to date . . . do you?

CHICAGO SEWAGE EQUIPMENT

All Chicago Sewage Equipment is specifically designed and engineered to handle and treat sewage and industrial waste. Superior performance and long trouble-free life are assured. Every unnecessary operating problem is eliminated; maintenance costs are low. Designed and engineered for each operation, the job is always done best with Chicago Sewage Equipment.

Specifically designed and engineered for comminution and grit removal

COMMINUTOR

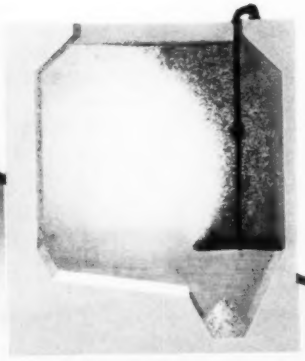
The only equipment that unfailingly cuts coarse sewage matter into small settleable solids without removal from the channel. Over 2500 installed since 1934.

1. Precision Engineered
2. Ruggedly Constructed
3. Properly Designed Cutters and Shear Bars
4. Controlled Feed and Flow

AER-DEGRITTER

The only method of removing organic-free grit and sand from sewage without cloggable mechanical equipment.

1. Maximum Removal
2. Clean Grit
3. No Mechanisms to Clog
4. Air Controlled Velocities
5. Low Cost
6. Simple Structure



Visit our Exhibit at the

F. S. I. W. A.

CONVENTION

October 8-11

Municipal Auditorium • St. Paul, Minnesota

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

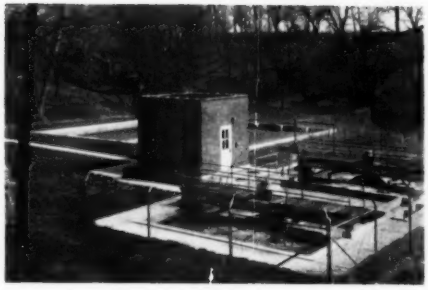
2300 WOLFRAM STREET

CHICAGO 18, ILLINOIS

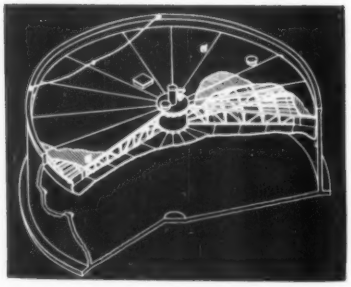
CHICAGO SEWAGE EQUIPMENT

CHICAGO 'PAKAGE' PLANT

Specifically designed for small communities, institutions and industrial plants, the Chicago 'Pakage' Plant combines in one installation all functional equipment found in a big city activated sludge sewage treatment plant. Low initial and operating costs, with minimum supervision required. Operators, without previous experience, successfully run plants and perform other municipal duties. Over 200 units installed since 1934.



CHICAGO-WIGGINS PONTOON COVERS AND GAS HOLDERS



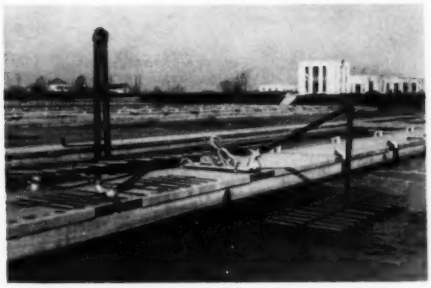
Now the Chicago-Wiggins Pontoon Cover, designed specifically for sewage digesters, combines the experience of Chicago Sewage Equipment Engineers and John H. Wiggins. Over 4000 Wiggins Floating Covers have been installed in the last 25 years. Chicago-Wiggins Pontoon Covers, Gas Holders and Lo-Dek Covers incorporate the latest techniques in design and construction, providing greater strength with less weight and with ample safety factor. Chicago-Wiggins Covers cannot tip.

Specifically designed and engineered for sewage digesters

CHICAGO-WIGGINS LO-DEK COVERS · TRU TEST SEWAGE SAMPLERS

Specifically designed and engineered for activated sludge sewage treatment plants

CHICAGO SWING DIFFUSERS AND PRECISION DIFFUSER TUBES



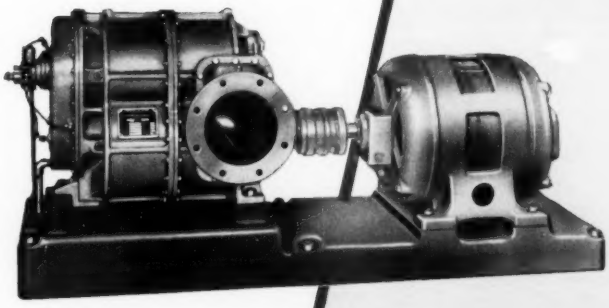
Continuous operation of an aeration battery is possible only with Chicago Swing Diffusers. No stand-by tanks are necessary. Chicago Precision Diffuser Tubes permit the most economical operation of an aeration battery. The Tubes are easily cleaned at a cost of only 10c. Swing Diffusers have been installed in over 200 plants since 1937.

1. Low first cost—no standby tanks.
2. Continuous operation at maximum efficiency.
3. Economical operation—less power consumed —less labor.
4. Tubes easily and economically cleaned.

CHICAGO STANDARDAIRE BLOWER

The Chicago Standardaire Blower is the most efficient, quiet, compact blower designed for sewage treatment. Air is delivered in a steady stream. No backsurge to cause pounding and clatter. Because of this greater efficiency, lower applied horsepowers are needed per C.F.M. of air. Precision engineering and select materials insure long life under continuous operation.

20 to 15,000 C.F.M. Up to 20 psi.



CHICAGO PUMP COMPANY
SEWAGE EQUIPMENT DIVISION

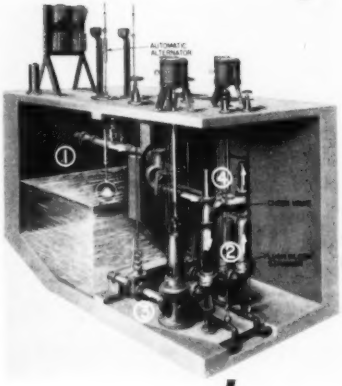
HEAT EXCHANGERS · CHICAGO NON-CLOG PUMPS · WATER SEAL UNITS

CHICAGO SEWAGE EQUIPMENT

Specifically designed and engineered for pumping sewage and sludge

FLUSH-KLEEN EJECTORS

The Chicago Flush-Kleen Sewage Ejector is the *only* positively clog proof sewage pump. The impellers handle only strained sewage. No solids can clog impeller or cause excessive wear on shaft and bearings. No manual attention required except for periodic lubrication.



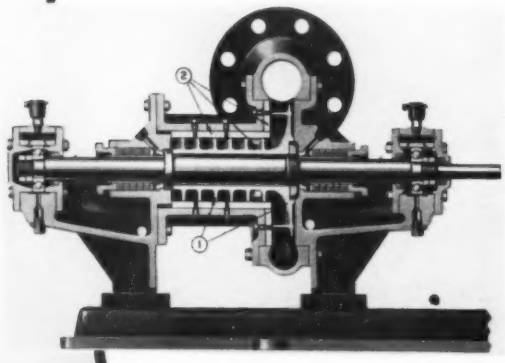
Filling Wet Well

1. Sewage flows through inlet pipe.
2. Coarse matter is retained on strainer.
3. Strained sewage flows through idle pump to wet well.

Pumping

3. Strained sewage is pumped from wet well.
2. Coarse matter is backwashed on strainer.
4. Special check valve closes. Sewage and coarse matter are pumped to sewers.

SCRU-PELLER SLUDGE PUMPS

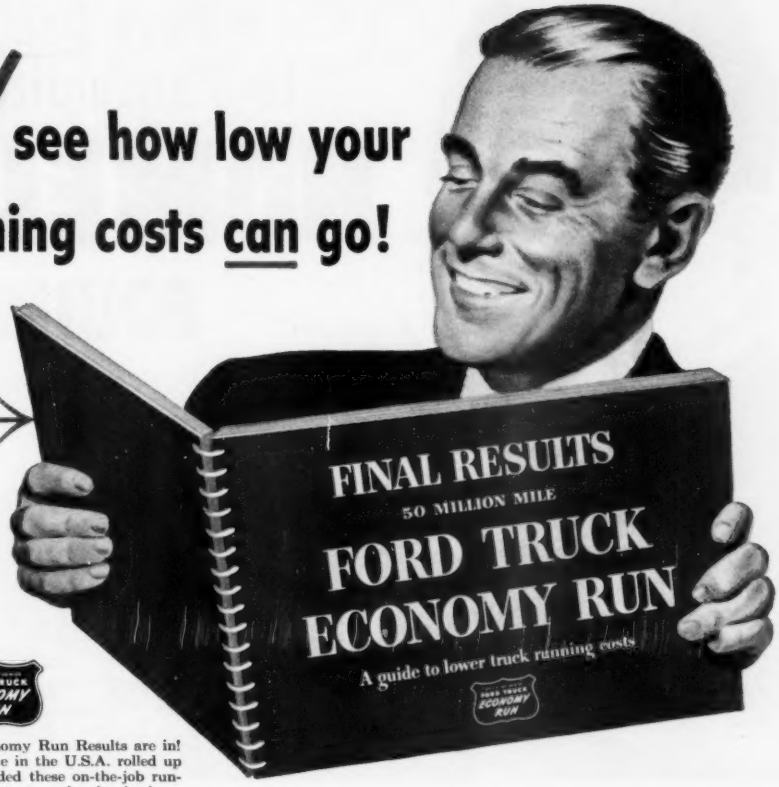


The Scru-Peller Pump is specifically designed to handle sludge. Coarse, stringy material is cut and cannot wrap or bind the impellers.

1. Screw and Impeller are keyed to the shaft and firmly held against the shaft shoulder by the shaft nut. The screw has two flights: the impeller two blades. Each screw flight in the conveyor is connected with its own impeller.
2. Cutting edges consist of four stellited cutting bars and a shear ring in the pump casing. The stellited screw edges and the edges of impeller blades act against cutting bars and shear ring, completely chopping all coarse solids into small pieces that cannot clog or slow the pump.

CHICAGO PUMP COMPANY
SEWAGE EQUIPMENT DIVISION
2300 WOLFRAM STREET CHICAGO 18, ILLINOIS

Now see how low your truck running costs can go!



A FORD DEALER EXCLUSIVE!

This 144-page book is a record of over 5,500 cases . . . on-the-job truck running costs in over 195 kinds of truck-using businesses. It's another Ford first, and *only* your Friendly Ford Dealer has it!

FORD TRUCK ECONOMY RUN

Final Ford Truck Economy Run Results are in! Owners from every state in the U.S.A. rolled up 53,783,930 miles—recorded these on-the-job running costs. Every important truck-using business was represented in the 6-month Run, every size Ford Truck, every kind of road and load condition.

"I truck 8 tons of sand for less than 4½¢ a mile!"

—says Adolph Ulmer, Jr., Ulmer Sand & Gravel Co., Beaver Dam, Wisconsin

Mr. Ulmer was one of over 250 heavy construction operators who entered the nationwide Ford Economy Run. His POWER PILOT equipped Ford F-7 Dump Truck traveled 18,956 miles at a cost of only $825.30 for gas, oil, maintenance and repairs!

You'll find his complete running cost record on page 62 in the "Final Results" book. See how *your* truck running costs stack up with other heavy construction men from all parts of the country—men whose loads and working conditions are similar to yours. See evidence of Ford Truck Economy!

New "Final Results" book gives black-and-white evidence of how *little* it can cost to run a Ford Truck in *your* kind of work!

Now check your truck costs against "par"! The "Final Results" book is a practical "yardstick" that lets you compare your running costs with the actual experience of other truck users in your kind of job.

See these cost-to-run figures today! There's no obligation. Your Ford Dealer will be glad to show you over 5,500 reports . . . arranged so that you can easily find cases with loads and working conditions similar to yours. See actual running costs for gasoline, oil, maintenance and repairs, paid for by actual truck operators, on actual jobs!

It may save you real money! See how important it is to have the truck *exactly* right for your job. Before you buy any truck, see written evidence of how little Ford Trucks cost to run in *your* type of business . . . in *any* type of business!

FORD TRUCKING COSTS LESS

. . . because Ford Trucks last longer! Using latest registration data on 7,318,000 trucks, life insurance experts prove Ford Trucks last longer!

See "Ford Festival" starring James Melton on NBC-TV.

It Pays Double to Standardize on HOMELITE *Carryable* EQUIPMENT

Homelite Carryable Pumps
for fastest automatic pumping on all types of dewatering jobs

Homelite Carryable Generators
for instant, dependable power, for floodlights or electric tools

Indeed it does! In the first place when you standardize on Homelite Pumps and Generators you give your men the best. Easy to operate, *sure* to operate, they're all powered by the famous Homelite built-in gasoline engine . . . a dependable, weather-proof, dustproof, foolproof engine that assures best performance at all times.

What's more, when you standardize on Homelite equipment you cut your maintenance problems to the minimum. Your nearby Homelite field service branch, completely stocked with standard Homelite parts can keep your units in perfect shape always *and economically.*

Homelite Factory Branches
throughout the country bring service right to your door

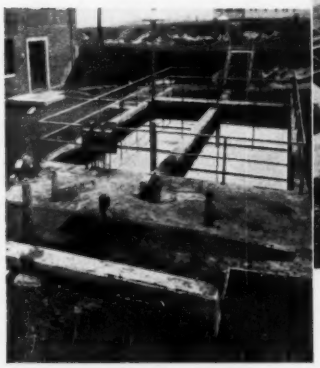
Manufacturers of Homelite
Carryable Pumps • Generators
Blowers • Chain Saws

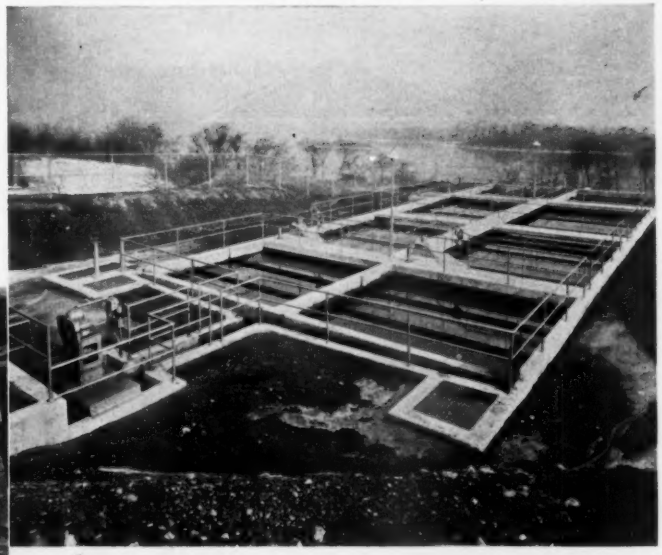
PERFORMANCE · DEPENDABILITY · SERVICE

HOMELITE
CORPORATION
2110 RIVERDALE AVENUE • PORT CHESTER, N. Y.

Need more facts about advertised products? Mail your Readers' Service card now.

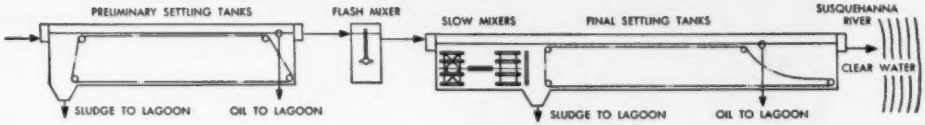
Settleable solids and floating oils are separated in the two 9 x 52 x 6 ft. preliminary settling tanks by L-B Straightline Collectors and Rotoline Skimmers.





Link-Belt flash mixer intimately mixes alum and lime for flocculation. Slow mixing is performed by two L-B mixers, parallel to the flow, whose speed is varied by P.I.V. Variable Speed Drives. Two final settling tanks, 18 x 90 x 8 ft., also have L-B Straightline Sludge Collectors and Rotoline Skimmers.

How to halt stream pollution



Completely LINK-BELT-equipped waste treatment plant removes oil and suspended solids at world's largest freight classification yard

COOPERATING with Pennsylvania's Clear Streams Program, the Pennsylvania Railroad recently completed an efficient waste treatment plant at their Enola (Pa.) yards. Designed by Gannett, Fleming, Corddry & Carpenter, Inc., consulting engineers, the plant is laid out for an average flow of 2.0 mgd, with a 4.0 mgd maximum storm flow.

To separate efficiently the solids and oils resulting from locomotive washing, ash quenching, sanitary sewage and storm water, surface loading is carefully controlled. At design flow, the preliminary tanks are limited to 2140 gal. per sq. ft. per day . . . the final tanks to 260. Sludge and oil removed are lagooned.

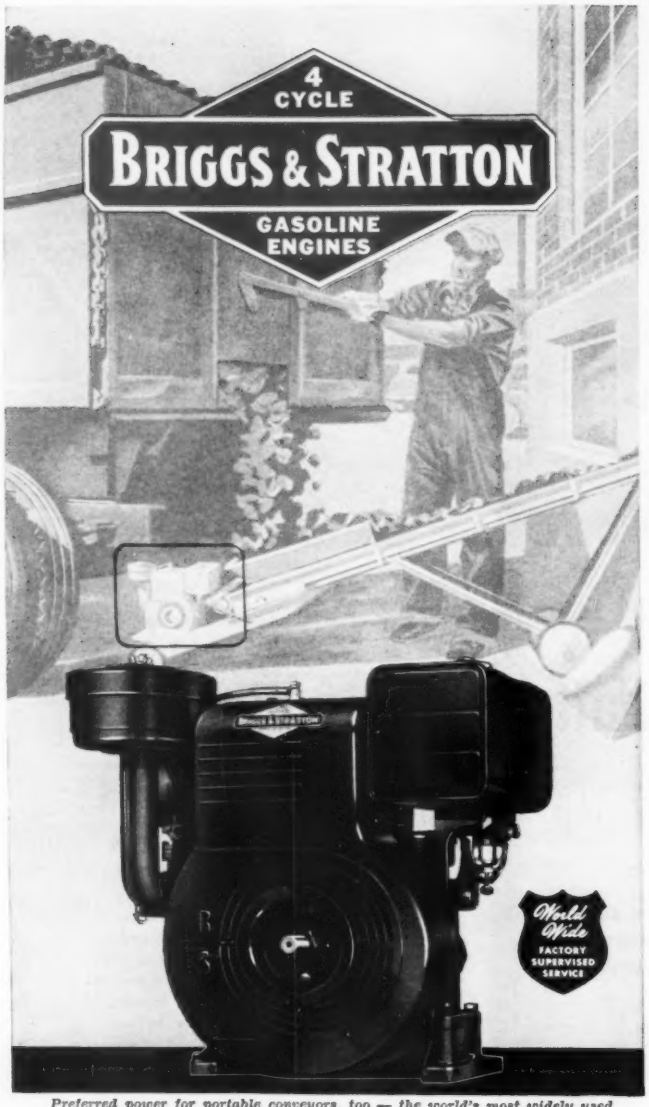
Whether it's for a compact industrial waste plant or a large metropolitan water or sewage treatment works, you'll find it pays to rely on Link-Belt equipment. Our sanitary engineers will work with your consultants and chemists —help you get the best in modern water, sewage or industrial liquids treatment.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,500

Visit our exhibit, booths 8 and 9, at the Federation of Sewage and Industrial Wastes Associations Convention, October 8th-11th, St. Paul, Minn.

LINK BELT

SANITARY ENGINEERING EQUIPMENT



Preferred power for portable conveyors, too — the world's most widely used single-cylinder 4-cycle, air-cooled gasoline engines on machines and tools for industry, construction, railroads, and on appliances and equipment for farm and home.

THERE is a Briggs & Stratton engine service organization, factory trained and supervised, near you — with a stock of genuine Briggs & Stratton parts for all models. The Briggs & Stratton service organization network is the largest of its kind in the world. Briggs & Stratton Corporation, Milwaukee 1, Wis., U. S. A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

It's a fact . . . our handy Readers' Service card is the easy way to get new catalogs.

LETTERS

TO THE Editor

ALASKA & PUBLIC WORKS

Re Alaska work: I spent the month of May up there, mostly in Juneau, but did get a few days in Anchorage. Then Joe Alter called me on July 13 asking me to help him on plan reviews. We have good flight connections out of here and I reported in at Joe's office on the 18th. Actually, I can be in Anchorage or Fairbanks the next day after leaving here, if space is available.

As you know, Alaska is really booming now. Alaska Public Works is building a lot of public improvements, such as water systems, schools, etc. Costs of construction are very high—at least 2 times stateside at the cheapest and 3 or 4 times at the highest. Everything else is high, too—58 cents for two tomatoes and $165 a month for a 1-bedroom apartment in a frame building.

I like the one-page and two-page articles in your magazine. The entire make-up, particularly in the August issue, appeals to me (except the tiny cut at the bottom of page 45). I find I have gone through the August issue rapidly and yet have gained a lot of information. Congratulations, also, on your departure from the time-honored (and time-worn) custom of massing all consultants cards on one or two pages.

Lloyd K. Clark,
Clark & Groff Engineers,
Salem, Oregon.

WEIR LENGTHS & OVERFLOWS

The editorial in the August issue of your magazine on weir length and overflow rates for primary tanks is of great interest. The settling tanks at Minneapolis and Elizabeth, N. J., were compared recently. Minneapolis has six tanks 53 ft. by 290 ft.; Elizabeth has four tanks 75 ft. by 275 ft. Minneapolis has very long weirs; Elizabeth 75-ft. long weirs. The displacement period at Minneapolis is 2 hours and at Elizabeth 2.35 hrs. The Minneapolis sewage is much stronger.

The operating results at the two plants for five years are practically the same. The percentage of solids

Like the Hunter and His Dog . . .

they Go Together

ALL-WHEEL DRIVE

and ALL-WHEEL STEER

What makes it easy for the front truck to ride the bank? . . . ALL-WHEEL DRIVE!

What keeps the rear truck running smoothly down on the road? . . . ALL-WHEEL STEER!

On jobs like this, and hundreds of others, this pair of exclusive Austin-Western features works as a team to do better work, and more of it. A profusely illustrated catalog which tells the whole story is yours for the asking.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.
Subsidiary of Baldwin-Lima-Hamilton Corporation

Austin-Western

BALDWIN · BLH · LIMA-HAMILTON

Now's the time to mail this month's Readers' Service card.

removal at Minneapolis is 66% against 64.3% at Elizabeth, but the suspended solids in the Elizabeth effluent are lower. The overflow rates at the two plants are nearly the same—about 1200 gallons per sq. ft. per day.

M. B. Tark,
Associated Engineer of Design,
Department of Public Works,
Philadelphia, Pa.

SUBDIVISION SANITATION

The editorial in the July issue on sanitation and other problems in subdivisions touches a subject to which we have given much consideration. I am enclosing an article covering our experiences and the results of our studies in the hope that it will provoke discussion and lead to a solution of this difficult problem.

J. A. Salvato, Jr., Chief,
Bureau of General Sanitation,
Department of Health,
Erie County, N. Y.

SEWER TROUBLES

I have a problem and find nothing in the "Sewerage Manual" to help solve it. Our sewers have a very flat grade. A fish cannery near the upper end of a sewer line dumps wastes into the sewer which cause trouble. I would appreciate any information on how that waste could be treated before discharge into the sewer.

J. Benj. Hayes,
City Engineer,
Hoquiam, Wash.

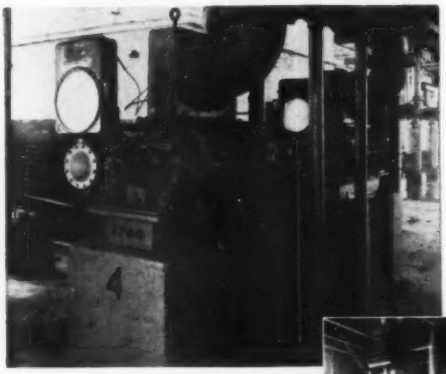
BOOKS IN BRIEF

CONSERVATION

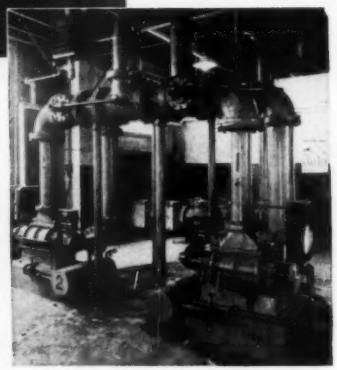
The New York City Department of Sanitation has published this brief booklet on conservation of tires, fuel and motor vehicle equipment with reference to refuse collection and disposal and street cleaning. Andrew W. Mulrain is Commissioner of Sanitation, New York, N. Y.

STAINLESS STEEL

A new data and handbook on the stainless steels, in its 120 pages, discusses approximately 40 different types of Allegheny Metal stainless steels and covers each type from



Part of an installation of nine R-C Meters in a large plant, some of which date back 10 years or more. Capacities range from 3,000 cfh to 130,000 cfh



YOU CAN ALWAYS

trust

R-C METERS

Continued repeat orders for R-C Positive Displacement Meters indicate the complete confidence of sewage treatment plant operators in the unvarying reliability of these units. Many have been installed so long that the original dates have been forgotten—yet they continue to measure as dependably as the day they were first put into service. That is because:

1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture, impurities or uncontrollable factors.
2. Accuracy is not subject to adjustment of meter or recorder by operators or other persons.
3. Accuracy is not affected by reasonable overloads.
4. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast iron surfaces.

Compactness of R-C Meters permits installation in cramped spaces. Sizes from 4,000 cfh to 1,000,000 cfh provide range for all sewage treatment applications. Indicating and recording devices are available. Ask for details in Bulletin 40-B-14 or write us about your needs.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Poplar Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

Thousands use our Readers' Service card to keep up to date . . . do you?

Check these DORRCO DISTRIBUTOR features

against high-rate trickling filter requirements

Distributors for high-rate trickling filters have to be *mechanically* right to handle heavy loadings. Check these mechanical features of the Dorrco Distributor against those of other units...

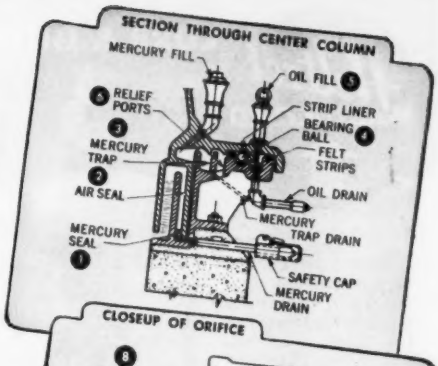
MERCURY SEAL... between rotating and fixed element (1) . . . is protected from contact with sewage by a positive air seal (2). In case of excess surge of pressure sufficient to blow the seal, the mercury is caught in an annular drain trap (3).

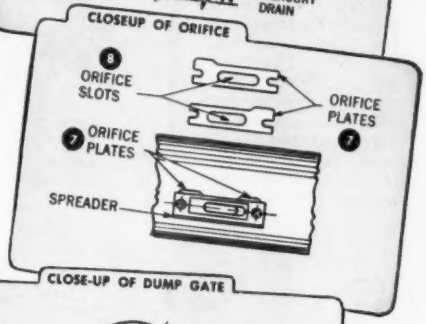
BEARINGS... Large diameter ball bearing race (4) running in oil at *base* of turntable for stability . . . is easily lubricated (5). Relief ports (6), provided for emergency overflow, prevent flooding of bearings under any circumstances.

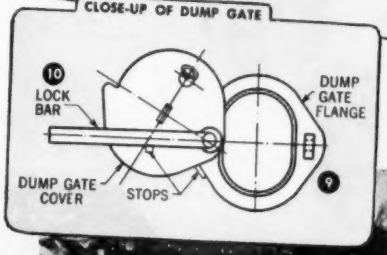
ADJUSTABLE ORIFICE PLATES... Two separate sliding plates (7) are bolted one upon the other to permit final flow adjustments. Orifice slots (8) are elongated to minimize clogging.

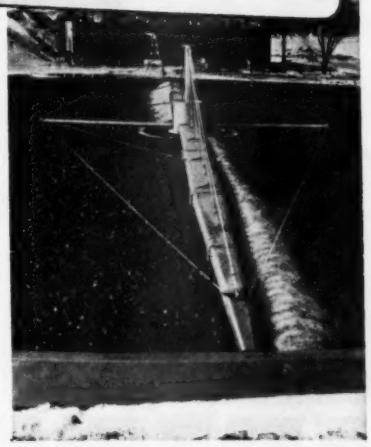
QUICK-OPENING DUMP GATE... provided at the end of each arm (9) is opened and closed easily by means of the lock bar (10).

Dorrco Distributors are available with two or four arms . . . having one or two compartments. On heavy duty units, the arms are of fabricated steel plate . . . tapered for better hydraulic performance and more uniform distribution. *The sum total of all these points is smooth Dorrco Distributor performance under the most severe of operating conditions.*









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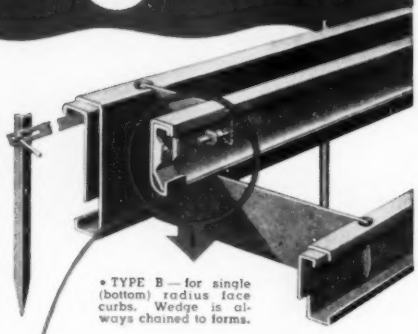
Heltzel BUILDS IT BETTER

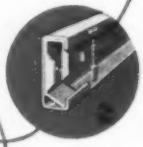
CURB & GUTTER FORMS

HAVE 3 INTERCHANGEABLE FACE FORMS



Heltzel steel forms augmented by various improvements through the years are the most rigid, advanced equipment obtainable. Your consideration of the many varied applications of these steel forms is respectfully invited. Write for Bulletin L-20.

• TYPE B — for single (bottom) radius face curbs. Wedge is always chained to forms.



• TYPE A — for straight face curbs (no radii). Slide lock is rigid, positive.

• TYPE C — for double radius (S-shaped) face curbs. Sliding dowels secure upper and lower extremities.

. . . and 3 Optional FACE CURB FORM SUPPORTS

HELTZEL

STEEL FORM & IRON CO.

WARREN, OHIO

Get full details of this month's new products . . . mail your Readers' Service card today.

standpoints of analyses, fabrication, heat treatment and special conditions. A selection table will help the reader greatly. Copy on request from Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

LEADERS IN THE PUBLIC WORKS FIELD

Frederick H. Zurmuhlen, Commissioner of Public Works for the City of New York, is largely responsible for the city's record-breaking program of public works design and construction which, over the past three years, has totalled more than $100,000,000. As head of the department which acts as municipal housekeeper for New York, he is responsible for maintaining and operating 62 public buildings, 49 bridges and 13 sewage treatment plants. He supervises 4,000 employees. Of particular interest to many readers is his responsibility for the tremendous program of sewage treatment plant design and construction now under way in New York.

He is an engineer and an architect. He received a degree of BS in engineering from Manhattan College in 1918; a CE degree in 1919; a Bachelor's degree in Architecture in 1929; and a doctorate in engineering in more recent years. During World War I, he was an engineer officer trainee at Camp Lee, Va. Following his discharge, he engaged in building construction, consulting engineering and architectural work; also he was with the PWA and the RFC; and during World War II, he was engaged on military construction in the Caribbean. In 1947, he was named Commissioner of Public Works of New York.

The Commissioner has three times been president of the New York State Society of Professional Engineers, and he has been active in many other professional organizations—the APWA, the AIA, the Military Engineers and the NSPE. He is married and, with Mrs. Zurmuhlen and the children, four sons and a daughter, lives on Staten Island.

Here's what WE mean by

EASY TO SERVICE

▶ Allis-Chalmers' new tractor line is blazing the way to simpler servicing with time and money savings never before possible.

▶ Adjustments are easier . . . lubrication simplified and lube periods greatly extended. Mechanics say these are the easiest tractors they have ever worked on!

▶ This all adds up to less down time, more producing time...longer tractor life at less upkeep cost.

▶ Following are just a few reasons why this NEWEST, FINEST TRACTOR LINE ON EARTH is *Easy To Service*...besides being built to "take it," easy to operate and entirely new in performance. Get the full story from your Allis-Chalmers dealer.

TIME-SAVING LUBRICATION DESIGN — Only a few lube points, easy to get at — NONE UNDER TRACTORS. You operate *75 HOURS* without any greasing — then only one fitting to hit and an oil change to make. (Only exception, torque converter bearings on HD-20). You lubricate the Positive-Seal truck wheels, support rollers and idlers only once every *1,000 HOURS!*

ACCESSIBLE ADJUSTMENTS — ***QUICKLY MADE*** — brakes, master clutch, steering clutches. No floor plates to remove for any adjustments. Tracks easier to adjust — simple screw adjustment with automatic lock.

EASY TO REPAIR — Engine, master clutch, transmission, steering clutches and final drives can be easily removed and repaired or replaced, *without disturbing adjacent assemblies.*

ALLIS-CHALMERS

TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

The Newest, Finest Tractor Line on Earth!

40.26 drawbar hp.
11,250 lb.

70 drawbar hp.
18,800 lb.

102 drawbar hp.
27,850 lb.

Hydraulic Torque Converter Drive
175 net engine hp.
41,000 lb.

- DESIGNED FOR YOUR JOB
- BUILT TO "TAKE IT"
- EASY TO OPERATE
- EASY TO SERVICE

When teamwork counts!

In her position, the young lady above feels pretty strongly about the importance of teamwork. And when you're attempting to control icy, hazardous streets—without corrosion, teamwork can mean a lot to you too. In this case, it's the unbeatable team of SALT and BANOX*.

Banox is the new phosphate material that *prevents* rust from forming on metals. A small amount of Banox (1% is sufficient to control corrosion) added to salt neutralizes the corrosive effects of road slush and brine . . . prevents the rusting of automobiles, bridges and highway equipment.

The Salt-Banox team keeps streets free from ice . . . eliminates motorists' complaints . . . reduces highway maintenance costs.

Keep your community progressive. Let us send you more information about this modern, *proven* method of snow and ice control.

*T.M. Reg. U.S. Pat. Off.

HAGAN HALL BUROMIN CALGON

calgon, inc.

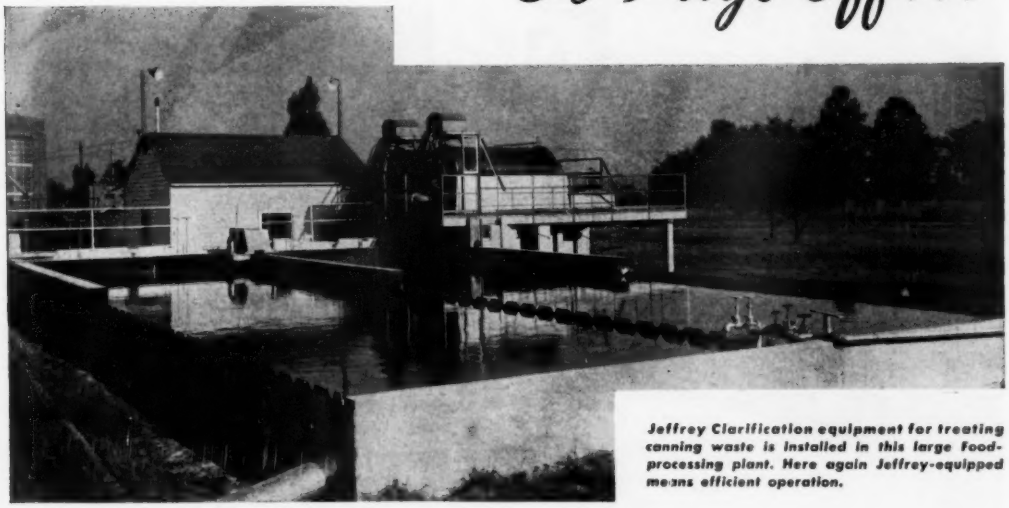
A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PA.

Now's the time to mail this month's Readers' Service card.

TREAT INDUSTRIAL WASTE RIGHT

It Pays Off...



Jeffrey Clarification equipment for treating canning waste is installed in this large Food-processing plant. Here again Jeffrey-equipped means efficient operation.

Industrial Waste is the Peck's Bad Boy in nearly every plant . . always in bad with the neighbors as well as State Pollution Control Commissions.

Clarification of industrial waste need not be such a bad problem. Jeffrey has the facilities for proper and efficient waste treatment . . can help you keep the nation's waters clean. For meeting exacting specifications we can furnish Collector mechanisms for Grit Chambers and Settling Basins, Screens, grease and oil Skimmers, Flocculation equipment, etc., backed by years of experience in designing and building the best in Sewage and Water treatment equipment.

We will be glad to send you some of the names of outstanding plants in which Jeffrey equipment is doing a real job on the purification of sewage and concentrated organic wastes . . and paying off. May we hear from you?

Bar and Disc-type Screens
Sludge Collectors
Sludge Elevators
Grit Washers and Collectors

FLOCTROLS (controlled flocculation)
Equipment for Biofiltration plants
Transmission Machinery
Scum Removers
Garbage Grinders

Chemical Feeders
Screenings Grinders
Belt and Spiral Conveyors
Chains and Sprockets

THE JEFFREY MANUFACTURING COMPANY

Established 1877

947 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

JM

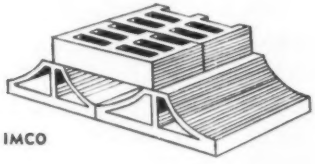
Baltimore 2 · Beckley, W. Va. · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 2 · Cleveland 15 · Denver 2 · Detroit 13 · Forty Fort, Pa. · Harlan, Ky. · Houston 2 · Jacksonville 2 · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 1 · Salt Lake City 1

Jeffrey Mfg. Co. Ltd., Montreal, Canada
British Jeffrey-Diamond Ltd., Wakefield, England
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S. A.
The Galion Iron Works & Mfg. Co., Galion and Bucyrus, Ohio
Galion (Great Britain Ltd.), Wakefield, England
The Ohio Malleable Iron Co., Columbus, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

Thousands use our Readers' Service card to keep up to date . . . do you?

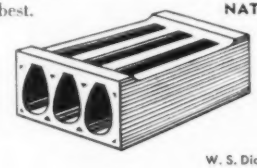
USE GOOD EQUIPMENT

There is only one right combination for better results in trickling filters: Top quality equipment and TFF Institute *specification* underdrains. You can't skimp on either. So don't jeopardize your reputation by using substitutes. Insist on rotary distributors made by any of the leading makers whose reputation for quality equipment is known. In sewage treatment it always pays to use the best.



IMCO

NATCO



W. S. Dickey Clay Mfg. Co.
Kansas City 6, Mo.

Need more facts about advertised products? Mail your Reader's Service card now.

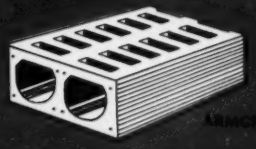
KLING FILTER Results

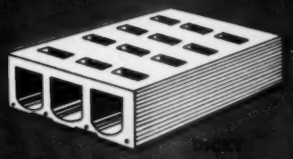
USE TFF INSTITUTE SPECIFICATION UNDERDRAINS

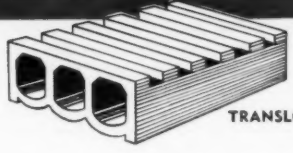
Trickling Filter Floor Institute specification underdrains are used in all modern filters where better results and trouble-free operation are desired. They are scientifically designed for that purpose and made of the finest quality vitrified clay. The size of the top openings insures proper ventilation of all the filter media and free discharge of the filter effluent. The run-off channels are extra smooth for non-clogging, quick drainage.

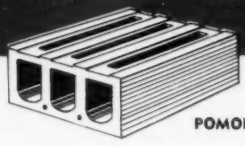
These blocks will [illegible] to fit NICAD. Unskilled labor can lay them easily because they are [illegible] and self-aligning. And the blocks are strong enough to work on after laying and to support safely even very deep filter media. They are best for all kinds and depths of filter.

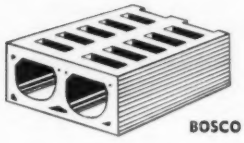
On your next filter, use the best equipment you can get . . . and give it a specification floor of *Vitrified Clay Filter Bottom Blocks.* Ask any member of this Institute for full engineering details. Write today.











These Underdrain Blocks are

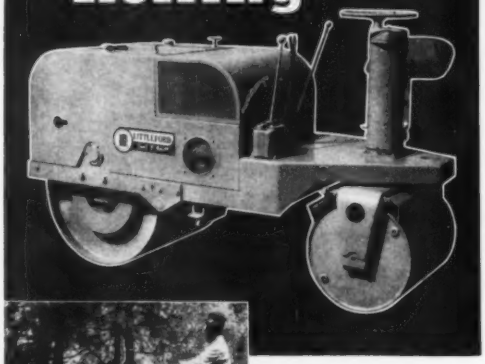
- EASY TO LAY
- ACID RESISTANT
- PROVED BY USE
- AND WON'T CLOG

TRICKLING FILTER FLOOR INSTITUTE

r-McCarel-Regan-Clay Co. Brazil, Ind. | Pomona Terra-Cotta Co. Pomona, N. C. | Texas Vitrified Pipe Co. Mineral Wells, Tex. | Bowerston Shale Co. Bowerston, Ohio | National Fireproofing Co. Pittsburgh 22, Pa. | Industrial Materials Co. Philadelphia 34, Pa.

Get full details of this month's new products . . . mail your Readers' Service card today.

For Low-Cost Rolling



Littleford's Model·157 Portable

TRAIL-O-ROLLER

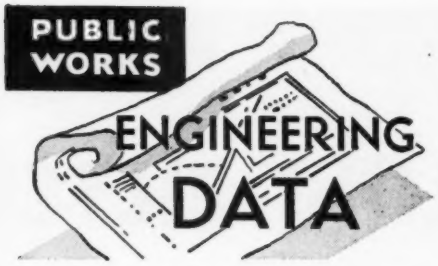
Here's the most modern 2 to 3 ton Portable Roller ever designed for rolling patches on Road Maintenance work, Tennis Courts, Bituminous Walkways, Parking Lots, Driveways, Drive In Theaters, Airport Runways or wherever compaction is needed. This Model 157 Trail-O-Roller with its variation in compaction is the utility work horse for Contractors, Highway Departments, Park Departments, Cities and Counties. Its Portability and the ease of changing from trailing to rolling or rolling to trailing position makes it the most desired Road Roller of modern times. No trailer is needed to move this Model 157 to and from jobs; it travels on its own pneumatic tired wheels. Rolling to Trailing Position or Trailing to Rolling Position is achieved by a Hydraulic Lift.

For low cost Rolling with a Modern Roller, this Model 157 Trail-O-Roller is the answer.

LB LITTLEFORD

BLACK TOP ROAD MAINTENANCE EQUIPMENT SINCE - 1900

LITTLEFORD BROS., INC.
452 E. Pearl St., Cincinnati 2, Ohio



Cost of Laying Water Pipe in Elmira

The cost of laying water pipe in Elmira, N. Y., during 1950, according to the annual report of the Elmira Water Board, John G. Copley, General Manager, was: For 2,000 ft. of 12-in., $6.06 per ft.; for 1,964 ft. of 10-in., $5.62; for 200 ft. of 8-in., $4.35; and for 3,878 ft. of 6-in., $3.78 per ft. Also, 2,412 ft. of ¾-in. to 2-in. were laid at an average cost of $2.26 per ft.

Cost of Laying Water Mains

THE annual report for 1950 of the Augusta, Me., Water District gives the length of pipe laid and the costs for material, labor and equipment. On 5,804 ft. of 10-inch cast iron line, with 17 10-inch valves, the labor cost was $1.02 per ft.; the equipment cost was $0.57 per ft.; and the material cost $3.74 per ft., a total of $5.33 per ft.

On 1,834 ft. of 8-inch cast iron pipe, with 3 valves, labor costs were 82 cents a foot, equipment costs 24 cents and material costs $2.74, a total of $3.80 per ft. for 8-inch pipe. The costs on 6,119 ft. of 6-inch, with 35 valves, were 61 cents for labor, 24 cents for equipment and $1.87 for materials, a total of $2.72 per ft. A section of 2-inch line 634 ft. long, with 3 valves, cost $1.91 per ft.

Bid Prices on Large Sewers

Bids were opened July 24, 1951, by the City and County of Denver, Colo., for the construction of the Northeast Storm Sewer. The three low bidders were: (1) Thos. Bate & Sons, to whom the contract was awarded; (2) Birchby & Nauman, Inc.; and (3) Peter Seerie, Inc., & M. J. Sears. The data were furnished us by T. G. Munroe, Office Manager, Department of Improvements & Parks of Denver. Unit bid prices for the three low bidders were:

Items	*Amount*	*(1)*	*(2)*	*(3)*
72-inch RC	7,635 LF	$27.80	$37.80	$36.67
66-inch RC	315 "	25.35	32.00	27.90
60-inch RC	1,505 "	22.20	28.00	24.70
54-inch RC	5,565 "	20.00	23.00	22.81
48-inch RC	12,480 "	15.75	16.00	17.70
42-inch RC	6,660 "	14.00	13.00	14.71
36-inch RC	4,436 "	13.00	11.00	10.47
33-inch RC	912 "	12.25	10.60	11.30
27-inch RC	340 "	10.50	8.40	10.15
24-inch RC	672 "	10.00	7.60	8.25
21-inch RC	700 "	9.75	6.90	7.00
12-in. Conc.	5,552 "	3.00	2.40	4.15

Various other items were included in the work. The contract award totalled $928,718.25; second low bidder was $1,029,184.20; and the third low was $1,048,184.52.

It's a fact . . . our handy Readers' Service card is the easy way to get new catalogs.

We don't seriously suggest that sponsoring the General Electric Disposall® will actually win you a permanent memorial—but across the country more and more community leaders are earning the sincere thanks of their communities through planning multiple installations of this revolutionary G-E appliance. This electrical marvel shreds food-wastes into tiny particles and then *washes* them away to septic tank or sewer. And public support for the G-E Disposall grows more enthusiastic every day.

What this modern, electrical, more hygienic method of garbage removal has already done for other progressive cities provides striking proof of the economy and effectiveness of municipal G-E Disposall projects of this kind.

In Jasper, Indiana, for instance, installation of G-E Disposalls is already complete in two-thirds of all homes. The city's garbage collection service has been suspended.

In Herrin, Illinois, and Mount Dora, Florida, whole groups of housewives—thanks to the action of local leaders—now get rid of food-wastes the G-E way, simply by turning the kitchen faucet.

If you are in any way concerned with civic planning or sewage treatment, *now* is the time to consider this revolutionary means of making your city a better place to live.

Let us send you this booklet

G-E DISPOSALL

CONVERTS FOOD-WASTE TO SEWAGE—ELIMINATES "GARBAGE"

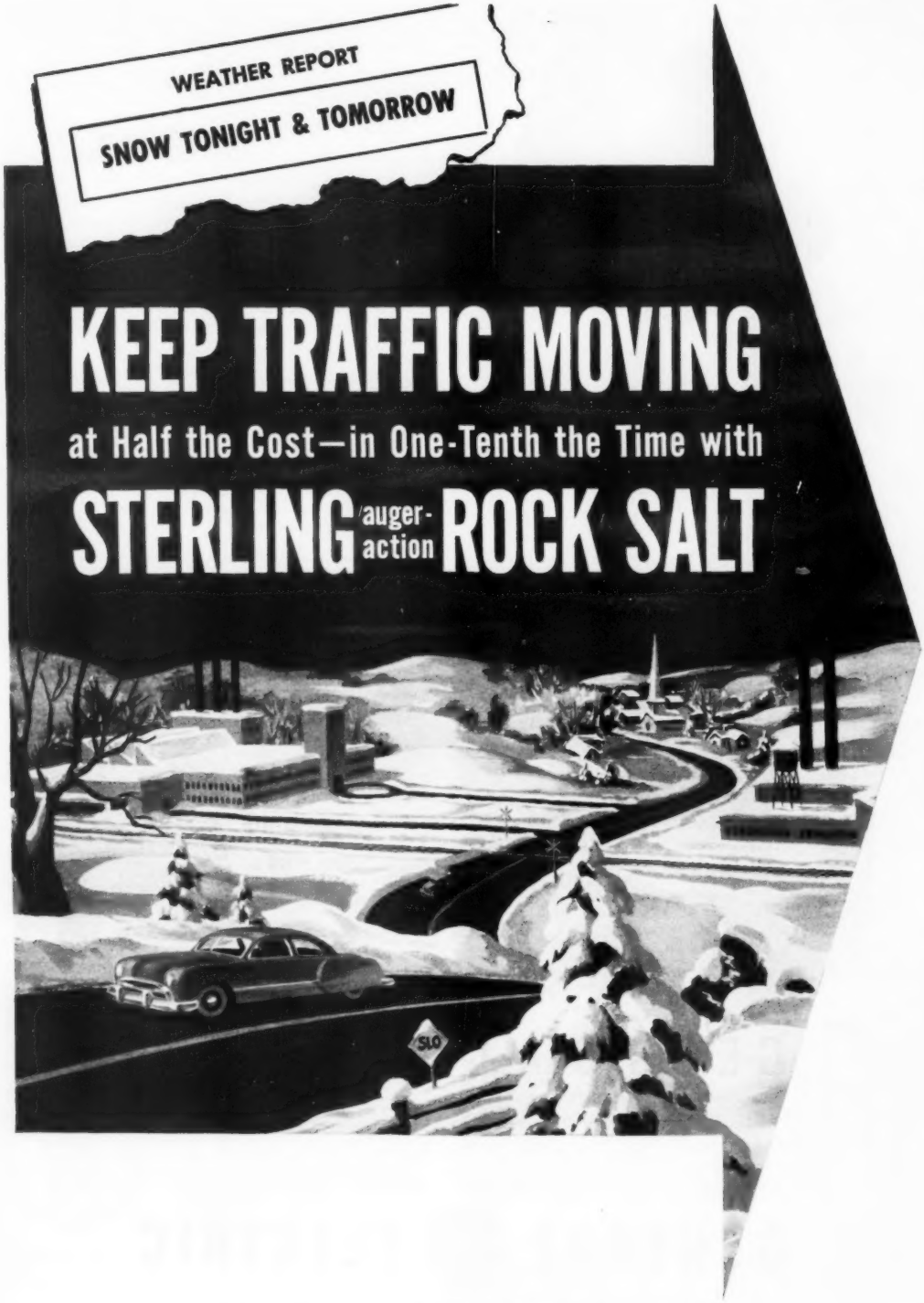
Trim and specifications subject to change without notice.

Let us send you *"What Was Garbage?"*—a guide to municipal Disposall installations—an authoritative booklet that answers your questions on this great new advance in sanitation. No cost or obligation—just write General Electric Company, Box P10, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

Now's the time to mail this month's Readers' Service card.



Thousands use our Readers' Service card to keep up to date . . . do you?

How one snow-belt county saved time and money with Sterling AUGER-ACTION Rock Salt

Comparative costs of protecting icy highways with treated sand and rock salt

SAND MIXED WITH ROCK SALT:

Royalty	$ .10
Loading	.25
Haul, 5 miles at 8¢	.40
Piling with bulldozer	.15
Treating with salt at 50 lbs. per cu. yd.	.43
Reloading at time of storm	.25
Average haul, 10 miles at 8¢	.80
Spread	.10
Total cost per cu. yd.	**$ 2.53**
Use of 3 cu. yd. per mile at $2.53	**7.59**

STRAIGHT ROCK SALT:

CC Grade Rock Salt: (400 lb. per mile, computed for 5-ton load)

5 tons of bulk salt at $12.95 per ton	$64.75
Loading, 5 tons at 25¢ per ton	1.25
Average haul (30 miles at 8¢ per ton-mile) 5 tons	12.00
Spread (mechanical) 5 tons at $1.00	5.00
	$83.00
$83.00/5 ton ... per ton =	**16.60**
$83.00/25 miles ... per mile =	**3.32**

UNIT SAVINGS:

$7.59 cost per mile with treated sand

$3.32 cost per mile with Sterling Rock Salt

$4.27 SAVING PER MILE EACH ICING IN FAVOR OF ROCK SALT

Mileage of state highways = 216 miles

ESTIMATED SAVING EACH STORM =

216 x $4.27 ... $922.32

A BARE Pavement is the only SAFE Pavement!

And Sterling Auger-Action Rock Salt gives you "bare" pavements. For each coarse rock salt crystal bores through ice and snow right down to the pavement. Here it becomes brine. And this brine spreads out and breaks the bond between the road surface and the ice. Heavy traffic spots treated with coarse Sterling Auger-Action Rock Salt clear themselves with the passage of vehicles. Less traveled areas can be cleared with one pass of the plow or scraper.

Result: at far less cost, in far less time—you get *bare* pavements—the *only* safe pavements.

Get Ready for a Safer Winter

Comes in carloads, bulk, or 100-lb. bags. *Order NOW!*

STERLING AUGER-ACTION ROCK SALT

INTERNATIONAL SALT COMPANY, INC., SCRANTON 3, PA.

HYATTSVILLE, MD., REPORTS:

Thomas G. Vivadelli, of Nance & Vivadelli Co., says: "The use of Dresser Couplings in the installation of this 42" steel water main for the Washington Suburban Sanitary Commission, was a great help in cutting our installation costs. Not only do they save labor costs, but they also make a tighter line. We would highly recommend the use of Dresser Couplings on any project of this nature."

A DRESSER-COUPLED STEEL LINE delivers water cheaper

Be sure you get the best line at the best price. Put steel pipe and Dresser Couplings in your specifications.

The cheapest way to deliver water to the place where it turns into revenue is with a Dresser-Coupled steel line—the line that cuts *installation* costs, *leakage* losses and *maintenance* costs.

Speed in getting water to a new housing or defense project is usually of great importance. Both to the construction schedule of the project and to your own installation costs. And, with a Dresser-Coupled steel line, you save time two ways. First, the long, strong sections of steel pipe mean fewer joints per mile. Second, those joints are more quickly made with Dresser Couplings because these factory-made joints are easy for any workman to install—even in wet weather.

Leakage losses are cut because with Dressers you get controlled gasket pressure, provided by controlled bolt tightness around the joint. Also because these gaskets harmlessly absorb stresses of vibration, contraction and expansion.

Maintenance costs are reduced by permanent joint tightness. Furthermore, with Dressers there is no heat in joint-making to damage the glass-smooth pipe lining. High carrying capacity is sustained.

From all standpoints, a Dresser-Coupled steel line gives you the ultimate in performance and economy. See your Dresser Sales Engineer or write our Bradford Office for literature.

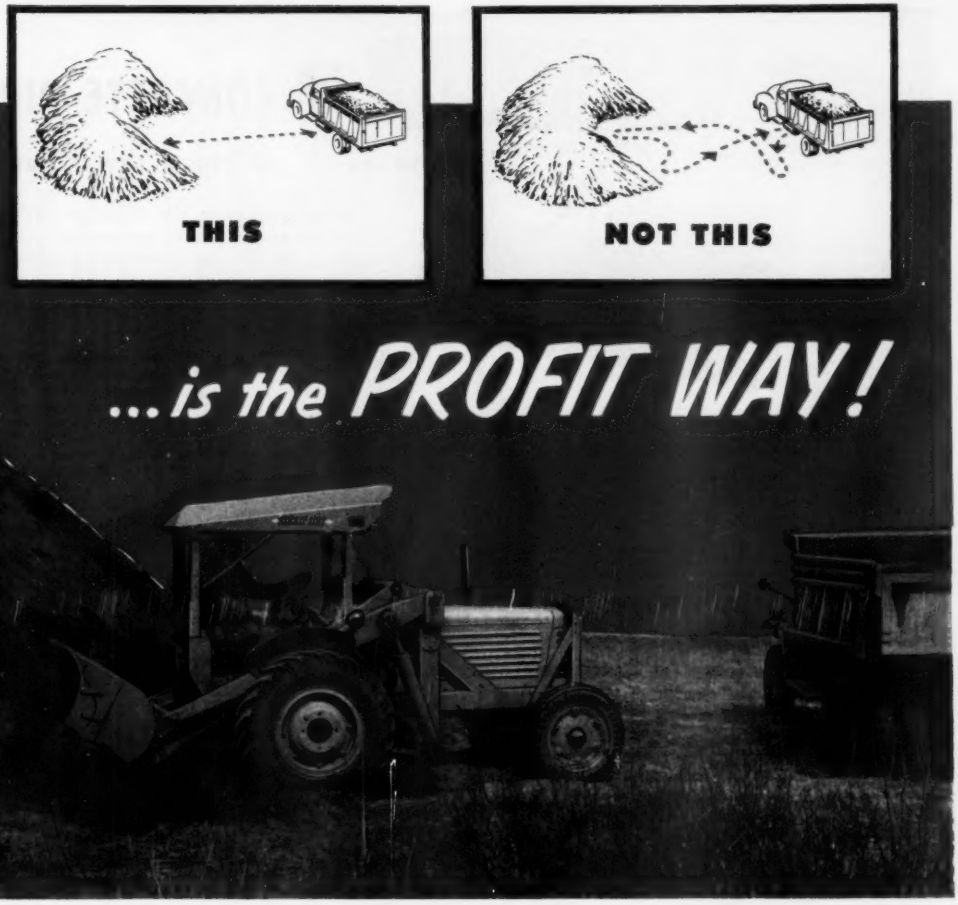
DRESSER

"FLEXIBLE-TIGHT"

COUPLINGS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: 629 Adelaide Street, W., Toronto, Ontario.

Get full details of this month's new products . . . mail your Readers' Service card today.



You cut out costly loading "detours"... save time and effort . . . with an Oliver Industrial Wheel Tractor and Strait-Line Loader. This revolutionary hydraulic, double end tractor-loader can load either in front or rear . . . dump in front. The operator can load and dump without twisting or turning the tractor . . . travel a *straight line* between pile and truck.

Rear-end digging gives you far more loads with far less effort. "Push-Tilt" bucket with penetrating lips gives you a bigger load every time. With bucket carried in the rear, *and low,* additional traction is created, assuring far greater mobility and maneuverability in any kind of going. Rear-carried bucket puts increased load on rear wheels for increased traction . . . lightens load on front wheels for far easier steering.

Investigate the Oliver—Strait-Line for your operations. Your Oliver Industrial Distributor will give you the complete details. Or, write The Oliver Corporation, Industrial Division, 19300 Euclid Avenue, Cleveland 17, Ohio.

THE OLIVER CORPORATION

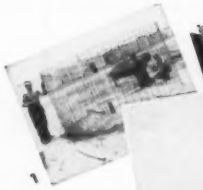
A complete line of industrial wheel and crawler tractors

It's a fact . . . our handy Readers' Service card is the easy way to get new catalogs.

Site-Cast 10' CONCRETE PIPE

saves 1/3 on storm sewer outlet

Comparative bids on this $1,600,000 Midland, Michigan, project showed pre-cast concrete pipe to be 1/3 cheaper than monolithic structure. In addition to a tidy cash saving, it was possible to use local labor and materials, and keep "sewer dollars at home."



SAVE TIME AND MONEY ON YOUR JOBS
Universal has made even 15' pre-fabricated concrete pipe a reality! This means savings all 'round on big jobs. No shipping costs, no handling delays. Write for details and FREE folder on Midland Project.

THE PICTURE STORY

1. Heavy reinforcement wire cage is set inside form before concrete is poured.
2. Internal vibrators are used after pouring forms. Result is pipe of uniform strength and density.
3. Site-casting brings the "factory" to the job, eliminates unnecessary handling.
4. Pipe is lowered into position, sealed and ready for use.

Universal plants in: Decatur & Dothan, Ala.; Tampa & Ocala, Fla.; Atlanta, Ga.; Kenvil, N. J.; Binghamton, Port Washington, Rochester & Syracuse, N. Y.; Columbus & Zanesville, Ohio; Norristown & Pittsburgh, Pa.; Nashville, Tenn.; Clarksburg and New Martinsville, West Va.

UNIVERSAL CONCRETE PIPE CO.
Home Office: 297 S. HIGH ST., COLUMBUS, OHIO

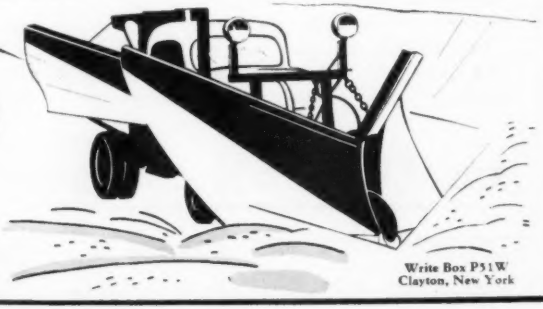
SAFER ROADS in WINTER

Heavily drifted roads, long continuous snows slow up the necessary transporting of vital commodities.

State, city and county highway engineers know that speedy snow removal and well-plowed roads mean less delay in transportation.

This is why the FRINK V-TYPE Plow is the choice of highway engineers for the tough job of snow removal. The exclusive self-ballasting feature of the FRINK guarantees even plowing, the full selective power hydraulic control assures faster plowing.

Write for these and other details on the FRINK and gain greater road safety this winter.



FRINK SNO-PLOWS

FRINK SNO-PLOWS, INC., CLAYTON, NEW YORK
DAVENPORT-BESLER CORP., DAVENPORT, IOWA
FRINK SNO-PLOWS of CANADA, LTD., TORONTO, ONT.

Write Box P51W
Clayton, New York

Now's the time to mail this month's Readers' Service card.

Non-clogging two-vane closed impellers, grease-lubricated anti-friction bearings, easy accessibility to the split stuffing-box gland and impeller eye . . . are typical of the many Worthington MIXFLO *features assuring low-cost, trouble-free sewage pumping.*

How is Bridgeport's Sewage Pumped?

It's full of industrial waste . . . a problem built for Worthington Pumps

Here's another municipality which has turned its sewage pumping over to Worthington—100%.

These five Worthington Vertical MIXFLO sewage pumps are located in Bridgeport's Westside sewage plant—installed in 1946. Three are 20-inch, two are 16-inch MIXFLOS.

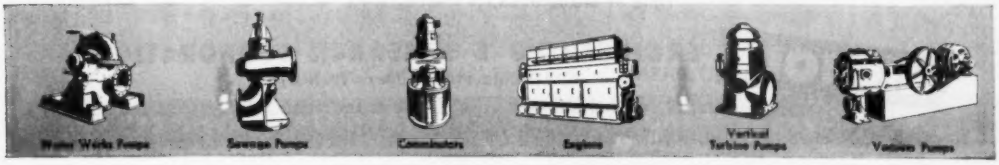
Bridgeport's Eastside plant duplicates these five pumps, and in addition uses two Worthington dry vacuum pumps and a Worthington air compressor.

In many other places, too, Worthington—world's largest manufacturer of pumps—is keeping pace with developments in sewage treatment and disposal by furnishing pumps of utmost dependability.

The Worthington MIXFLO line offers the industry's widest choice of sizes and types. So take a tip from New York, Chicago, Philadelphia, Bridgeport—find out why *there's more worth in Worthington.* Write Worthington Pump and Machinery Corporation, Public Works Division, Harrison, New Jersey.

WORTHINGTON

SEWAGE PUMPS W.1.1



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The Lowest Priced Two-Inch Pump Of Its Capacity On The Market!

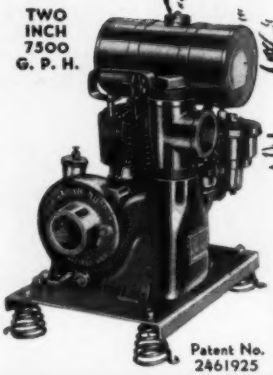
The Pelican is the Quickest Priming, Fastest Pumping, "never quit" pump available, - it challenges any pump its size and type to equal its performance.

- **Suction lift** - up to 25 feet at sea level.
- **Automatic Self-priming** - no ports or valves, - just start the pump and you start the water.
- **Portability** - constructed of sturdy cast aluminum with carrying handle for easy portability. One man can easily handle the Pelican.
- **Non-Clogging** - any muck or solids that will pass the intake strainer will pass through the pump.
- **Simplicity** - the impeller, the only moving part, is mounted directly on the engine shaft and operates at engine speed.

There are so many practical uses for Gorman-Rupp Lightweight Pumps that it is impossible to list them. They are invaluable for utility and municipal applications. Their trouble-free performance and Gorman-Rupp guarantee are your positive assurance of satisfaction.

Write for bulletins 1-LW-13 and 7-LW-13.

THE GORMAN-RUPP COMPANY
MANSFIELD, OHIO



Patent No. 2461925

The Pelican 2" - wgt. 70 lbs. 7500 g.p.h. - Primes in 99 sec. at 25 ft. suct. lift.

The Midget 1½" - wgt. 62 lbs. 5500 g.p.h. - Primes in. 75 sec. at 25 ft. suct. lift.

The Hawk 2" - wgt. 110 lbs. 10,000 g.p.h. - Primes in 47 sec. at 25 ft. suct. lift.

The Eagle 3" - wgt. 117 lbs. 18,000 g.p.h. - Primes in 79 sec. at 25 ft. suct. lift.

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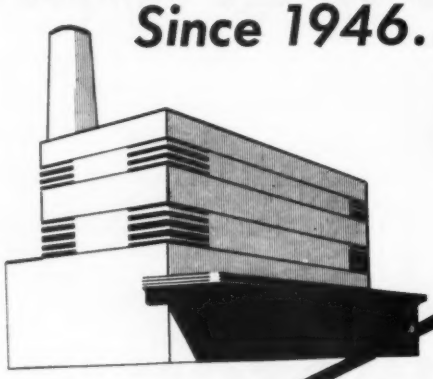
Since 1946....



6 Monohearth Type (Mechanically Stoked)

to

1 All other types Combined

Monohearth type mechanically stoked refuse incinerators installed since the end of World War II have 6 *times* the daily tonnage capacity of all the other types of refuse incinerators constructed in the same period.

The record shows clearly the wide acceptance of an established principle of incineration.

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Plan your air raid warning system *now!*

Remember these basic facts:

Horsepower is no true measure of sound output

Decibel output is no true measure of effective sound distribution

A successful air raid system is not that which has the most powerful warning device nor yet the one which produces the greatest decibel output at 100 feet or other specific distance.

The effective air raid system is one which blankets every area completely with ample and unmistakable penetrating sound waves.

Centrally located large signals simply cannot do this because buildings, trees, hills, and other obstacles block off, deflect, or reflect the sound waves. Wind, humidity, altitude and temperature all conspire to alter the distribution of sound.

"Super" signals may produce 100 times the volume of a small signal. By simple arithmetic it should cover 100 times the area. The truth is that sound distribution functions by higher mathematics, not arithmetic. Simple arithmetic doesn't take into consideration the obstacles to sound travel encountered in congested municipalities where air raid sirens are needed and used.

The more congested the area, the more signal devices required to blanket it, regardless of size. Ponderous, oversize devices cost infinitely more for blanket coverage per square mile than smaller signals. In extremely congested areas, it takes almost as many "whooper-doopers" to assure blanket coverage as it would smaller sirens.

Dollar for dollar, 2, 3, or 7½ horsepower sirens will do the job better and more dependably. Cities which used the giant models in World War II have turned to smaller sirens in this emergency. Philadelphia, Newark, New Orleans, Hartford, Providence, El Paso, and Buffalo have had or are now installing the finest air raid systems. Draw on their wisdom and experience. We will be glad to give you honest and sincere assistance with your air raid signal problem. Write us and ask for Bulletin No. 95.

DANGER—

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CREATIVE FILTER ENGINEERING

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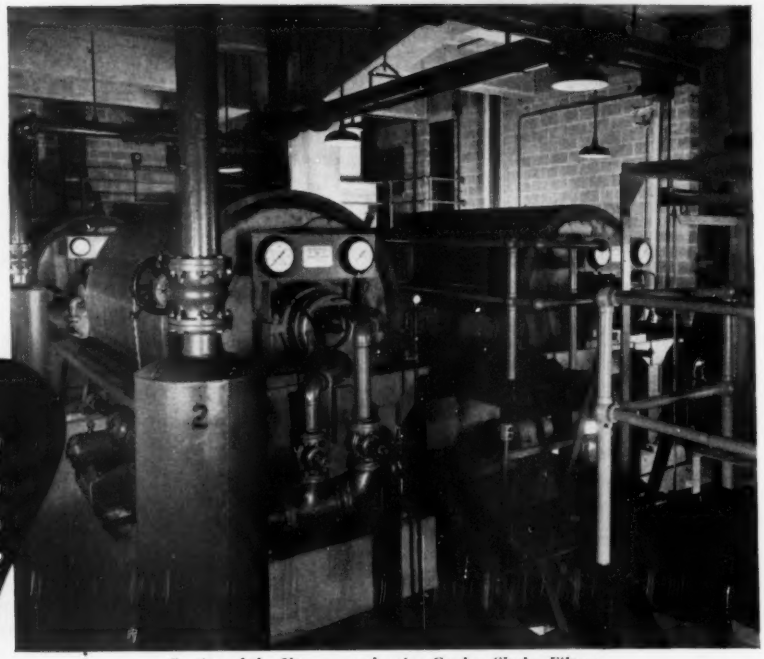

Section of the filter room showing Conkey Sludge Filters in recently opened Bridgeport primary treatment plant.

Newly completed Bridgeport, Conn., Sewage Treatment Plant uses Conkey Sludge Filters

Bridgeport's new East Side primary treatment plant handles a high percentage of diversified industrial wastes. Careful planning plus several unique innovations were required to successfully dewater and incinerate this sludge. It was essential that the sludge filters . . . *heart of any sewage treatment plant* . . . would dewater rapidly, continuously and automatically at the lowest possible cost. Conkey Sludge Filters were selected and have provided *better filtration* . . . fulfilling each necessary requirement perfectly.

Typical Conkey Sludge Filter features are the effective plastic backing plates for filter cloth support, the Uscolite pipe lines and drainage bells, the efficient double scraper arrangement, specially formulated protective coatings and many newly developed components made of special plastics.

Bridgeport, Chicago, many other cities . . . private industry in many places . . . all have found that creatively engineered Conkey Sludge Filters "do a better job" and do it at minimum cost. Bulletin No. 100 on Conkey Filters belongs to every progressive sewage engineer. Write for your copy today.

Other General American Equipment:
Turbo-Mixers, Evaporators, Thickeners, Dewaterers, Dryers, Towers, Tanks, Bins, Pressure Vessels

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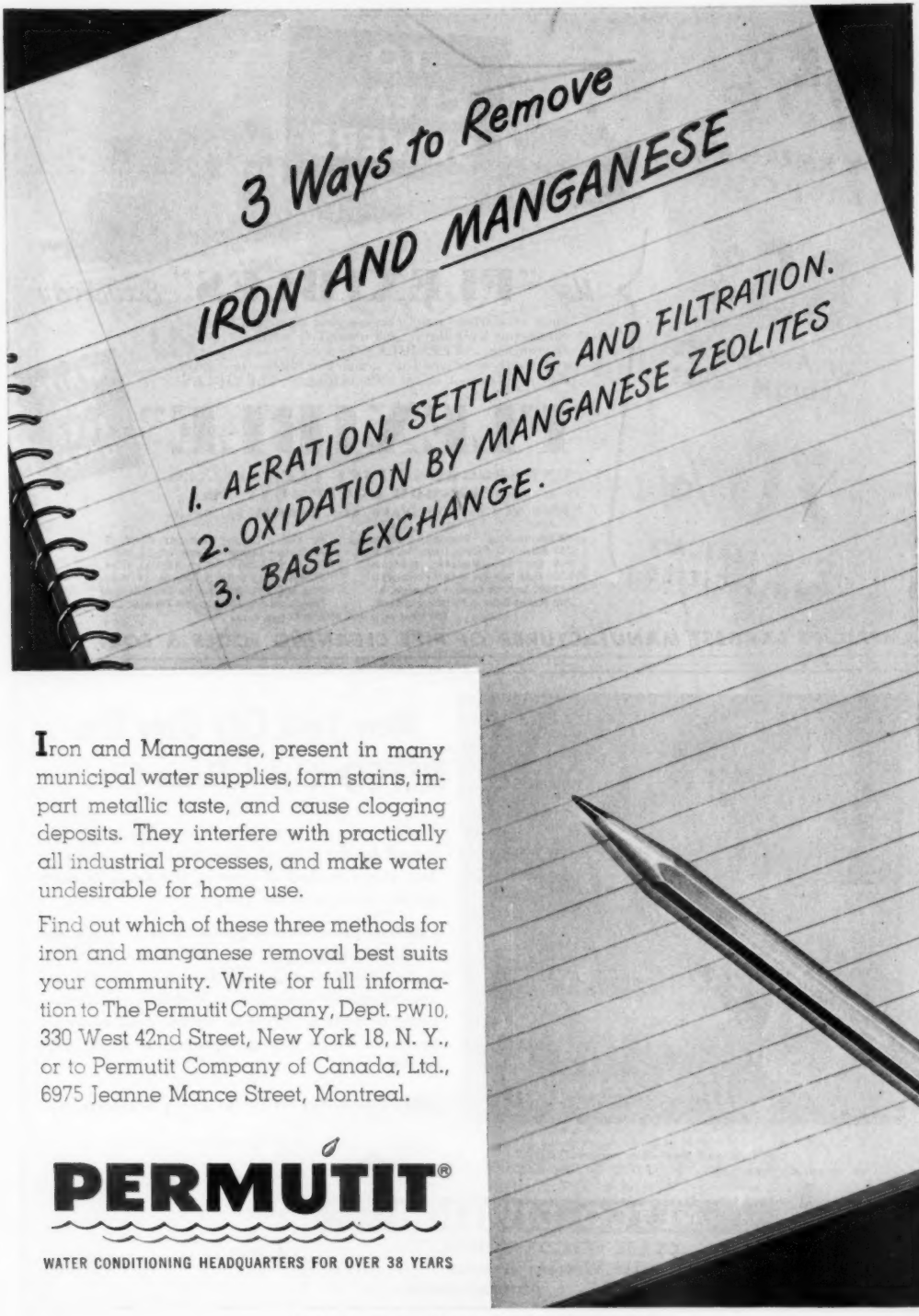
It's a fact . . . our handy Readers' Service card is the easy way to get new catalogs.


3 Ways to Remove
IRON AND MANGANESE
1. AERATION, SETTLING AND FILTRATION.
2. OXIDATION BY MANGANESE ZEOLITES
3. BASE EXCHANGE.

Iron and Manganese, present in many municipal water supplies, form stains, impart metallic taste, and cause clogging deposits. They interfere with practically all industrial processes, and make water undesirable for home use.

Find out which of these three methods for iron and manganese removal best suits your community. Write for full information to The Permutit Company, Dept. PW10, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

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New York City Uses The NETCO *Catch Basin Cleaner*

Here is one of five Netco Catch Basin Cleaners owned by the City of New York and used as a fast, cheap method of cleaning thousands of catch basins throughout the city.

Efficient, money-saving performance — each machine averaging 20 to 30 catch basins a day — is the reason many larger cities have bought and are enthusiastic about Netco. The Netco with pneumatic controls is simple to operate and easily removes all debris through openings as small as 16 inches.

NETCO—A Necessity for Every Municipality

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CLARK-WILCOX COMPANY
118 Western Avenue
Boston 34, Massachusetts

Fluoridation News

1945 1951

IN TEXAS, TOO—

CITY OF MARSHALL

MARSHALL, TEXAS

January 24th, 1951

Wallace & Tiernan Co. Inc.
1112 National City Bldg.
Dallas 1, Texas

Gentlemen:

The City of Marshall, Texas began fluoridation of its municipal water supply in the Spring of 1946, under the jurisdiction of the Texas State Health Department. Marshall was the first city in the State of Texas to use fluoridation.

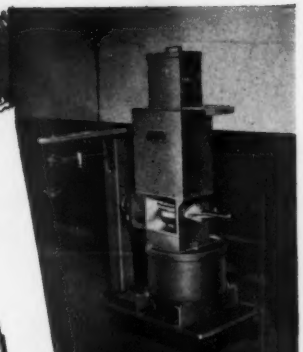
In February 1950, we changed our method of fluoridation by feeding sodium fluoride with a Wallace & Tiernan Type NA Dry Chemical Feeder.

We have found the Wallace & Tiernan Type NA Feeder to be simple in operation, easy to adjust and maintain, and extremely accurate for feeding sodium fluoride. We have been able to hold the fluoride content of our treated water very constant by using this feeder.

We would be glad to recommend this feeder to any town considering adding fluorides to the public water supply.

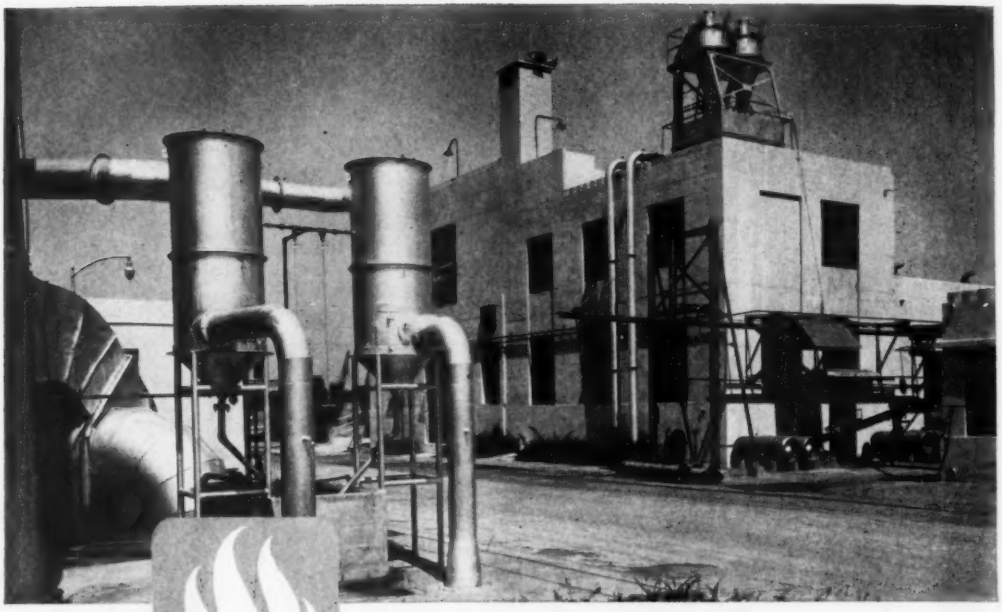
Very truly yours,

CITY OF MARSHALL
J. W. SCHONHARDT
Water Superintendent



When *your* community is ready to look into fluoridation — and after you have consulted your State Department of Health — you'll find W&T Engineers ready and willing to help you.

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES



New C-E Flash Drying Unit at San Diego Extension

...almost triples capacity of original installation

When San Diego's Sewage Treatment Plant went into operation in 1943 it was equipped with a C-E Raymond Flash Dryer Unit designed to handle 63 tons of filter cake per day. Shortly after the war plans were made to increase the capacity of the plant to meet the growing needs of the San Diego area.

In June of 1950 the San Diego Extension went into operation, serving an equivalent population of more than 500,000. The C-E Flash Dryer Unit at this extension handles almost double the amount of filter cake as the original unit — 110 tons per day. The evaporation rate of the second unit is about 5000 pounds per hour.

San Diego Extension, as well as the original installation, is typical of C-E Raymond System installations, now in service in virtually all parts of the country, meeting the varying requirements of both large and small communities. They are flexible in layout, highly efficient and thoroughly reliable; they provide for maximum utilization of waste heat.

The services of C-E specialists are available to assist you in finding the best solution to your sludge problem. Get in touch with the office nearest to you for prompt attention. B-525

Representative list of C-E Raymond installations since 1945

BALTIMORE, Md.	SAN FRANCISCO, Calif.
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FOND DU LAC, Wis.	WATERBURY, Conn.
HOUSTON, Texas	WYOMISSING VALLEY, Penna.
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COMBUSTION ENGINEERING—SUPERHEATER, INC.

1315 North Branch Street **FLASH DRYER DIVISION** Chicago 22, Illinois

Western Office: 560 W. Sixth, Los Angeles 14, Calif. Eastern Office: 200 Madison Ave., N. Y. 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

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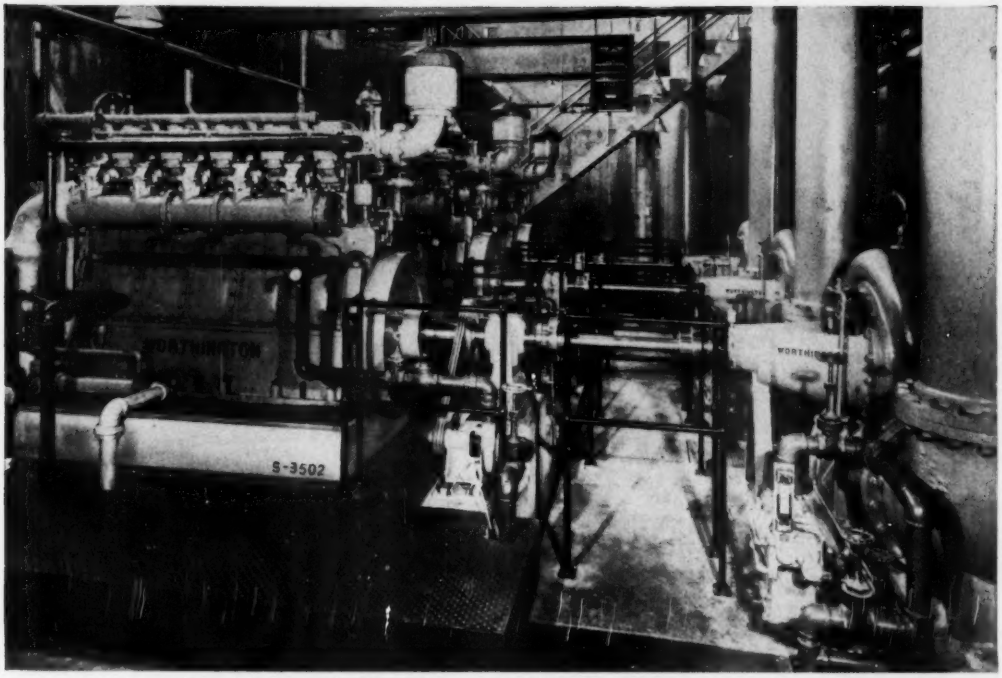

Three of seven Worthington 4-cycle gas engines —driving three Worthington 20 mgd recirculation pumps.

Nothing Wasted... Maximum Efficiency

AT OKLAHOMA CITY'S MODERN SEWAGE TREATMENT PLANT

The engines that run the pumps are fueled by the gas generated from the sewage sludge.

The rate of gas generated is accelerated by the heat from the engine cooling water.

Even the engine exhaust can be utilized for the digestor heating if necessary.

These are a few of the features of the outstanding new Southside Sewage Treatment Plant at Oklahoma City.

Again—Worthington equipment fitted the special requirements of the job. Worthington had the right engines for the available fuel—in this case, a gas engine was selected because natural gas is available as stand-by fuel.

And again—Worthington furnished not only the engines, but also the pumps . . . four 20 mgd raw sewage pumps and three 20 mgd recirculation pumps . . . in addition to such other equipment as air compressors.

Worthington is an important factor in sewage treatment and a predominant choice for modern plants because it offers such a broad range of equipment: engines for any available fuel, plus the world's most complete line of pumps, comminutors, air compressors, water treating equipment, motors and power transmission equipment. One manufacturer, one responsibility.

For *more worth in Worthington*, call on our nearest office, or write to Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

WORTHINGTON

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ECONOMICAL CONTINUOUS POWER
Diesel Engines, 150 to 2,640 hp . . .
Gas Engines, 190 to 2,880 hp . . .
Dual Fuel Engines, 345 to 2,640 hp.

WORTHINGTON-BUILT AUXILIARIES

Engine Starting Compressors

Oil Transfer Pumps

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Traction-Speed-Mobility

You get more of everything with this rubber-footed tractor-shovel. With its combination of 4-wheel drive and large pneumatic tires the Model HM PAYLOADER gives you fast-action traction on all kinds of footing — on sand, stone, snow, clay or mud. It gives you crawler-like traction at far less maintenance expense, PLUS speed when you want it and the ability to work on pavements and travel over streets and highways at 16 M.P.H.

You also get easy operation and maneuvering speed thanks to power-boosted steering and full reversing transmission with 4 speeds reverse as well as forward. Once you see one in action you'll know why hundreds of contractors as well as road and street officials are highly satisfied users of Model HM PAYLOADERS. Full information on this and other sizes of PAYLOADERS is yours for the asking. The Frank G. Hough Co., 761 Sunnyside Avenue, Libertyville, Illinois.

WRITE for literature on any size PAYLOADER: the 1½ yard Model HM; the 1¼ yard HY; the ¾ yard HF; the ½ yard HE; the 12 cu. ft. HA. There is no obligation.

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PUBLIC WORKS Magazine

OCTOBER, 1951 VOLUME 82 • NO. 10

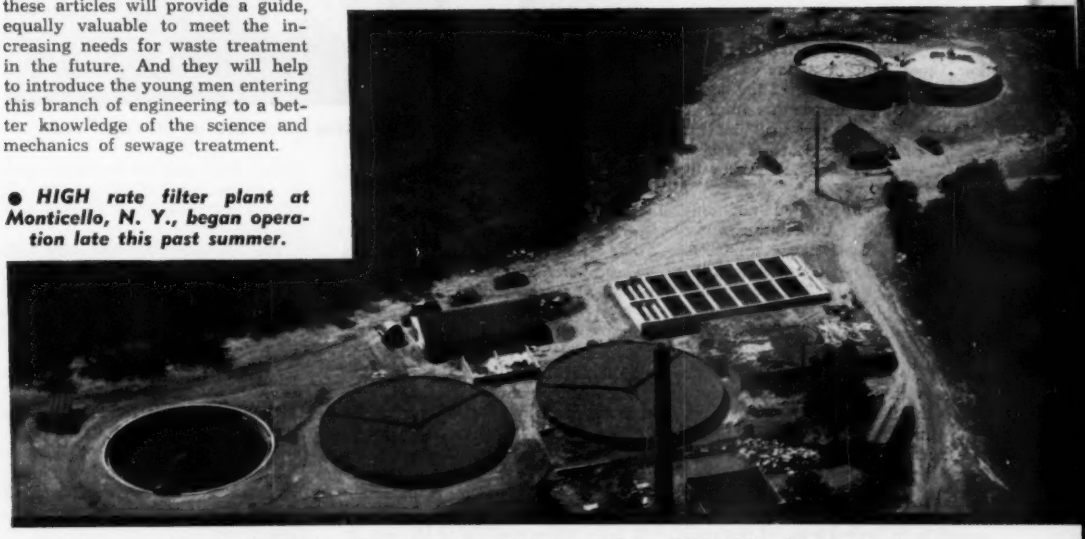
SEWAGE TREATMENT FOR THE NATION'S NEEDS

NOTABLE in any collection of literature relating to sewage treatment methods and equipment are the articles starting on page 61 of this issue. Prepared by men who are outstanding in this field of work, these articles are designed to provide basic information on all major phases of, and steps in, sewage treatment.

Primarily, the purpose of this series of articles is to provide, in one place, the kind of information that would be needed if this nation should enter a major emergency. In such a case, it would again be necessary to design, construct and operate scores, or perhaps hundreds, of sewage treatment plants to serve many kinds of defense and related installations. And because there is already a serious shortage of skilled sanitary engineers, it would be inevitable that engineers lacking a full background of experience in this field of work would be called on to design and construct such plants.

Under these conditions, this series of articles would be of inestimable value because they illustrate the best of modern practice and because they show the employment of modern equipment and devices as an essential and necessary part of a sewage treatment installation, both to produce a satisfactory effluent and to insure the lowest possible construction and operating costs.

If, happily, no emergency occurs, these articles will provide a guide, equally valuable to meet the increasing needs for waste treatment in the future. And they will help to introduce the young men entering this branch of engineering to a better knowledge of the science and mechanics of sewage treatment.



● ***HIGH rate filter plant at Monticello, N. Y., began operation late this past summer.***

Visit Public Works' Booth at the FSIWA Convention.

SNOW SHED PROTECTS CASCADE HIGHWAY

RAY BLOOMBERG

Although last winter was a severe one in the Cascade Mountains which stretch across the entire width of Washington state, vehicular traffic continued across them without interruption for the first time in recent years.

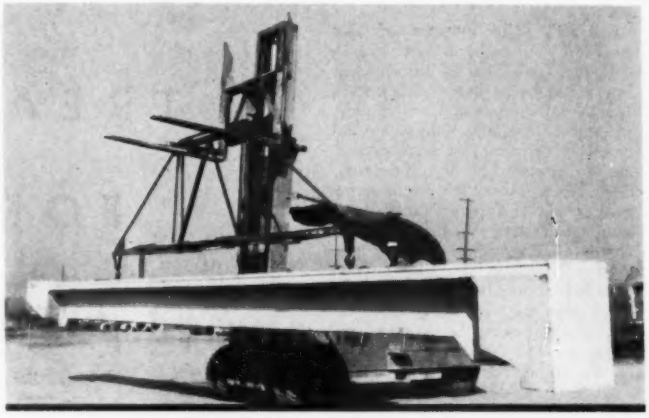
In other years, snow slides had blocked the cross-state Snoqualmie Pass highway at not infrequent intervals, causing trucks and cars to line up for miles. In the case of passenger cars, it was usually only an inconvenient delay but for the trucking companies these delays caused losses of thousands of dollars.

Last summer, the state highway department began construction of a snow shed 1300 ft. long at the most exposed point on the highway—Airplane Curve, where the terrain offered absolutely no protection against slides. Although the 1950 construction season was one of the shortest on record, the shed was ready for traffic by the time snow fell. Roadway paving and other work was completed this summer.

Because the construction season in the Cascade Mountains is so short, lasting only from April to November, time-saving methods were employed in construction of the shed's roof. This roof consists of reinforced concrete beams pre-cast in the Seattle plant of the Seattle Concrete Pipe Co. and trucked 60 miles to the job.

The pre-cast method not only saved invaluable time but resulted in a roof cost of $3 per sq. ft., as compared to an estimated $4 for conventional methods. The 520 beams employed in the Airplane Curve shed required only 12 days for erection.

Each T-beam section has a stem 9 inches thick and 21 inches deep below the flange. The beam flanges, 5-in. thick, which form the roof, are tapered slightly in width, from 2 ft. 6 5/16 ins. to 2 ft. 6 ins., because the shed is on a curve. Both ends of the beams are thickened and recessed to fit over the top of the wall and over supports at the lower end. A tapered hole, 2-in. diameter at the top and 1½-in. at the bottom, was formed at each end of the beam to take ¾-in. dowels set in the walls. These tapered holes were filled with grout after the roof was in place.



● *ONE of the 520 pre-cast T-beams for the roof of the shed.*

● *INTERIOR of shed, showing archways on downhill side.*

Since there was a ¼-in. gap between the flanges, a recess was formed above the open space and asphaltic filler placed therein, after which the recess was filled with cement grout and sealed with mastic.

Ten beams were cast at a time in steel forms. These were kept in the forms for 24 hours and another day was allowed for stripping and steam curing. Two 9-ton beams, each 40 ft. long, were trucked to the site at a time. Each was set in place within 10 minutes after the top of the retaining wall had been mopped with hot asphalt.

The counterforted retaining wall, on the uphill side, is 15 inches thick and 28 ft. 3 ins. high. The downhill side consists of a series of columns 2 ft. sq. on 20-ft. centers, connected by arched concrete beams.

The Airplane Curve shed and a second structure 500 ft. long at Lake Keechelus, replacing a timber structure, were built by C. V. Wilder and Gaasland Co., Inc., of Bellingham for $1,015,620. Engineering design was by the Engineering Staff of the Washington State Highway Department.

GOOD PUBLIC RELATIONS HELPS THE FLUORIDATION PROGRAM

E. S. BIDDLE
Delaware State Bacteriologist

THE water works that enjoys good public relations is in an enviable position. The Newark, Del., Water Department is one of those public services that has extremely harmonious relationships with those it serves. As a result of this, Newark is the only municipality in which the town council has voted for fluoridation as a result of the demand of the citizens, without any sparking by a Dental Society or State Board of Health. Newark is also fortunate in that it is the home of the University of Delaware, the Biochemical Research Foundation and certain of the research laboratories of Du Pont. The population of 6,500 contains a large percentage of scientific personnel and advice on this new program was readily available.

When Newark first became interested in fluoridation, the Town Council appointed a committee consisting of Dr. P. K. Musselman, a local dentist; Dr. A. P. Colburn, Acting President of the University of Delaware; Drs. Smith and Kramer of the Biochemical Research Foundation; F. Stegler, a local industrial chemist; and the writer, who is State Bacteriologist, to study the problem. This committee, after much investigation, including several trips to communities practicing fluoridation, recommended that Newark fluoridate its water.

It is not intended to state that all was clear sailing with the program. As a matter of fact, even after the detailed report of the committee, strong opposition developed and it required the combined support of the Parent-Teachers Association and of the civic clubs to obtain the approval of the Town Council. Much of the credit for the positive action taken by the Council should go to the PTA and to the mothers of preschool children.

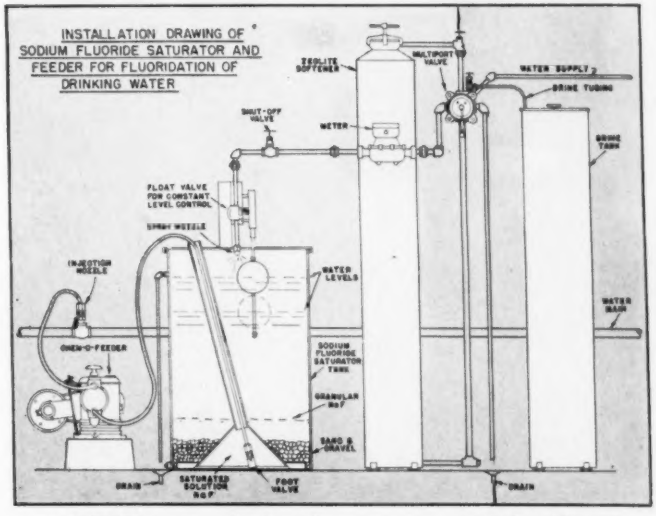
One interesting event during the campaign may bring a smile to those who remember the "innovation" of chlorination. A few months before the installation of the fluoridation equipment, complaints were received by the Water Department that the fluoride was producing objectionable tastes in the water. It was then explained to the objectors that the equipment was not even scheduled to be delivered for 30 to 60 days.

The Fluoridation Program

Newark obtains its water from four shallow wells. The natural fluoride content is reported as a "trace." This meant that 1.0 ppm would have to be added. Daily pumpage is in the order of 750,000 gpd. There is no other treatment.

The committee gave much consideration to the available fluorine compounds. Sodium fluoride was finally selected because the original experiments used this chemical. Furthermore, a continuous supply was assured. Since the salt was essentially neutral in character, it was not believed that its addition, in small amounts, would upset the chemical balance of the water.

Sodium fluoride (NaF) is a white, free - flowing, odorless product, available in powdered or crystalline form. The chemical purity is about 98% and the salt contains 45% fluorine. Therefore, 18.8 pounds of the commercial product is required to increase the fluoride content of 1 million gallons by 1 ppm. Sodium fluoride is the most soluble of the fluoride salts, but that solubility is not great, being 4.03% at 60°F and 4.11% at 212°F. Since solubility is essentially constant at any temperature, a saturated solution of sodium



● ***FEEDER type used; the softener was not needed at Newark.***

fluoride will have just about the same fluoride content all of the time. This is a characteristic used to advantage in the method of treatment used in Newark.

Since 18.8 pounds of the sodium fluoride are required to increase the fluoride content of 1 mg by 1 ppm, and since a 3% solution appeared to be the highest concentration that could be prepared readily by manual or mechanical stirring, about 56 gallons of solution would be required to treat Newark's 750,000-gal. daily flow. With two 400-gallon rubber lined tanks, one for mixing and one for storage, a week's supply of fluoride solution would be available.

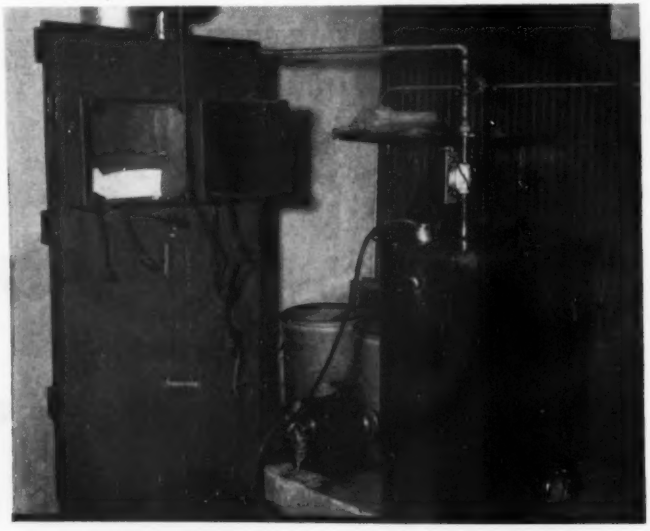
Choosing the Equipment

About the time that this matter was under consideration, the convention of the American Water Works Association was being held in Philadelphia. Members of the Committee, with J. Neide, city engineer of Newark, attended the convention and examined the various types of equipment available. All of the members of the committee were impressed by a Proportioneers unit designed automatically to make up a saturated solution of sodium fluoride. This is accomplished by allowing water to trickle through the crystalline sodium fluoride; and because a saturated solution of constant strength always results, the feeding problem is simplified.

The Proportioneers Saturator can hold as much as 450 pounds of crystalline sodium fluoride, but usually only 200 to 300 pounds are used in one filling. The Newark water supply is a pumped system and the feeder is electrically cross-connected to the pump motor starter. This insures operation of the fluoride feeder when the pump is in operation and renders it inoperative when the pump is not running.

By using the Saturator, the minimum of maintenance and attention is required, inasmuch as a 32-day supply can be made up by one addition of the crystalline sodium fluoride. By injecting into a pressure line and having the feeder motor cross-connected to the pump motor, it is impossible to overfeed. Practically no chemical storage space is required because a whole barrel of chemical can be added at one time. Because the water at Newark has a hardness below 75 ppm, the softener usually a part of fluoride installations in hard water areas is not required.

Operating experience over the past year has shown this equipment to be trouble-free, safe and efficient, requiring practically no attention. It was also economical in first cost. Installation was in November, 1950. At present, Newark is using a Taylor Water Analyzer to check the fluoride residual, and this has given very close checks with the Standard Methods steam distillation procedure.



● ***THIS is about all there is to the Newark installation.***

Solving

WATER JETTING SERVICE LINES

ERNEST D. DEEDS
Sup't., Division of Water, Lancaster, Ohio

We have developed a water jet method of running service lines from the main to the service curb stop. We use lengths of 1-inch pipe, not over 5 ft. long and we do not make a large excavation at the main. A jet cock is placed on the working end of the 1-inch pipe and a hose is connected to the other. This hose is connected to the tap in the main and a valve is placed between the main and the hose. By pushing and withdrawing the pipe, the jet action of the water, using our main pressure of 100 to 120 psi, cuts out an opening, allowing the pipe to be pushed ahead. New pipe sections are added as necessary. After reaching the curb hole, the pipe, if ½-inch copper, is pushed through the 1-inch galvanized pipe, which is then removed. If ¾-inch or 1-inch copper pipe is used, it is connected to the galvanized pipe which is then pulled out. A trench pump is used to remove the back water.

DRY ICE SIMPLIFIES REPLACEMENT OF CURB-STOPS

HARRY M. WOOSTER
Sup't., Old Town Water District, Me.

WE have a two-mile section of 8-inch main where the service lines have been renewed, but some of the customers' pipes were not replaced. In such instances, the old curb-stops were left in place. Whenever one of the customers wanted to replace his pipe, we had to dig out the corporation cock in order to shut off the line and replace the old curb-stop. To save this expense

WATER WORKS PROBLEMS

of digging out the corporation just to shut off the water, we developed the following method: A section of old inner tube about 20 ins. long is placed under the pipe; then about half a pound of dry ice is placed along the pipe and a little water sprinkled on it. Then the inner tube is clipped together to hold the dry ice around the pipe. With the curb stop closed, ten to fifteen minutes are required to freeze the water in the service. Then the dry ice can be removed, the old curb-stop taken off and a new one put in place.

Then it is necessary only to wait for the pipe to thaw. If in a hurry, heat can be applied. The method works nicely and saves a lot of needless pick and shovel work. I hope someone else can make use of this.

CIVIL DEFENSE PLANNING

FOR THE WATER DEPARTMENT

WALTER TURNER,

Sup't., Water Dep't., Cambridge, O.

In civil defense, we plan to use our regular employees, 25 in number, to meet the initial emergency. These men have been regrouped into small units, according to age, physical strength, special skills and place of residence. Critical areas are being declared restricted, and unauthorized persons found thereon will be subject to arrest.

At a general alarm, at least two persons are assigned to go immediately to each of the restricted areas; and in each case, certain specific duties are prescribed. No one goes alone to his assigned area. Private cars are used; public cars and trucks are to be used to move men and equipment for repairs. We anticipate complete breakdown of power service and telephones, and we are planning to communicate by means of messengers and police radio.

We have both steam and electric high lift pumps. In case of an actual attack, all elevated treated water storage will be held until damaged mains can be valved off. For fire fighting, we have a plan worked out with the fire department which is unique and practical. There would be no shortage of water even if several large mains were broken. Also, we are equipped to distribute treated water by tank truck.

LOWERING A WATER MAIN

LEROY BLOCKER

Sup't. of Utilities, Superior, Neb.

We lowered a 350-ft. block of 6-in. cast iron bell and spigot water main without unjointing and rejointing the line. The main was lowered about 4 ft. The most useful piece of equipment on this job was a Quickway backhoe. The backhoe operator dug a trench on each side of the main to the required new depth, cutting the earth from under the pipe as he progressed. As a length of main was uncovered and undercut, we suspended the pipe by using 4" by 4" timbers, chain hoists and guy jacks. After the trench was completed, the main was gradually lowered by slacking off the hoists and jacks a little at a time, moving up and down the main, so that each end was alternately the lowest. Lowering the main and leading the joints at each end took approximately 5 hours, and this was the only time that service was interrupted. The trenching on this job took 19½ hours.

EARTH BORING MACHINE FOR SERVICES AND SMALL MAINS

WILLIAM E. FALK, JR.

General Sup't., Water Dep't., New Albany, Ind.

The equipment that we have used most effectively during the past year was an Earthworm boring machine for the installation of services and small mains. We found this machine, when equipped with the proper bits for the type of soil encountered, to drill a straight hole in a very short time, with a minimum of manual labor. From the standpoint of public relations, this equipment is most valuable because it eliminates pavement breaking which is an interruption to traffic and, in turn, is detrimental to good relations. Another piece of equipment that we have used effectively during the past two years has been a Jeep automobile equipped with an Auburn trenching tool. This is capable of digging a ditch 6 inches to 12 inches wide at rates of 100 to 300 ft. per hour, depending on soil conditions.

FIRE PROTECTION FOR OUTLYING DISTRICTS

JOHN W. WALKER

Sup't., Light and Water Dep't., Cairo, Ga.

OUTLYING areas around Cairo are, in some cases, served by 2-inch water pipe. In order to give adequate fire protection to these areas, we have developed the following procedure: Two fire trucks answer the first alarm. One of these is a 500-gpm pumper carrying 350 gals. of water and 900 ft. of 2½-inch hose. The other is a 75-gpm pumper carrying 300 gals. of water and 300 ft. of 2½-inch hose. Each truck also carries two 1½-inch hose lines and 1-inch booster lines.

Both trucks report to the fire. If additional water appears to be needed, the 500-gpm pumper drops back to the booster point—the nearest hydrant connected to a 6-inch line. There it takes suction from the 6-inch hydrant and pumps into the 2-inch line through a nearby 2-inch hydrant at a pressure of 100 psi. The small truck then takes suction from the nearest 2-inch hydrant. Since most of the dwellings in these areas served by 2-inch lines are small one-unit houses, the system has been very effective, and it does not tie up all of a small department's equipment on a long hose lay. Our population is about 7,000.

With these two trucks in operation at a fire, we still have a 750-gpm pumper carrying 1600 ft. of 2½-inch hose and a 300-gpm pumper carrying 700 ft. in reserve. This system has proved so satisfactory that we have recently installed four more networks of this type.

PROBLEMS IN HANDLING LIQUID ALUM

A. H. LABSAP
Mgr., Water Dep't., Longview, Wash.

We have been considering the use of liquid alum in our water treatment plant, but have delayed because of the cost of installing the stock tank. Trucks of 4,000 gals. capacity deliver liquid alum daily to Longview, as several pulp mills use it. We would need a 5,000-gal. tank, 12 ft. in diameter, located on the storage floor of the filtration plant, 28 ft. above ground level, and this tank will have to be lead or rubber lined. We found such a tank would have to be knocked down as the opening into the plant is not large enough to permit entrance of the assembled tank. This would necessitate welding the tank in place and having someone make a trip here to install the lead or rubber lining. Eugene, Ore., has had the same problem and we are going to get some costs from them before proceeding further. Once installed, the cost of the coagulant should be a great deal less, as the alum could be pumped from the truck to the tank, whence it would flow by gravity to the mixing chambers of the treatment plant.

Corrosion in Private Water System Due to Electrolysis

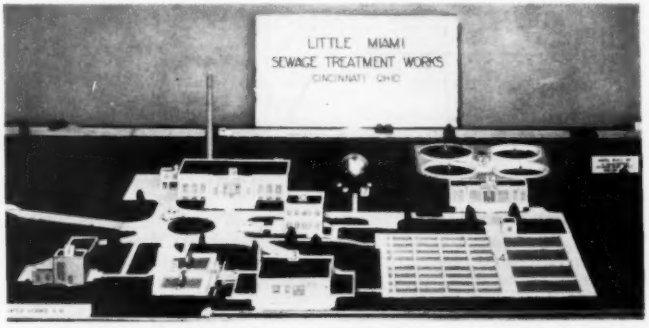
W. H. SHEFFIELD
Asst. Engineer, Fulton County, Ga., Health Department

A home water supply in Fulton County, Ga., consisting of a drilled well, jet type pump, and pressure tank, was overhauled a year ago, and much of the original galvanized pipe replaced with copper. Almost immediately the users noticed a change in the chemical nature of the water.

Inspection revealed three points where copper and galvanized pipes were joined. Chemical examination of samples from the kitchen tap showed the iron content to be around 1.5 parts per million so it was thought that an electric couple was being set up by the contact of the different metals and that iron was being freed from the galvanized pipe.

A short length of heavy plastic pipe was used at two points to eliminate the couples, and the iron content immediately dropped to 0.7 ppm. Later the third couple was eliminated the same way, and the iron quickly dropped to 0.5 ppm, a 66% reduction, the owner being well pleased with the results.

The plastic pipe used (Carlon) was attached with hose clamps but it can also be threaded to make a screw connection with a metal fitting.



● ***THIS is a scale model showing how Cincinnati's Little Miami Sewage Treatment Plant will look when completed.***

MODERN SEWAGE TREATMENT for CINCINNATI

CONSTRUCTION has just started in Cincinnati's Little Miami sewage treatment plant. Designed to handle 29 mgd of sewage, this is the first of four projected plants: One with a capacity of 120 mgd and two others of 5 mgd each. The 250,000-cy dirt-moving phase of the Little Miami project was started last spring by the James McHugh Construction Co. of Chicago, using International and Caterpillar tractors, Tournapulls, front-end loaders, sheepsfoot rollers, bulldozers and Bucyrus-Erie shovels. A 16-ft. levee will protect the plant from backwaters of the Little Miami River. The illustration shows a scale model of the proposed plant: (1) pump building; (2) grit chambers; (3) chemical building; (4) flocculation and settling tanks; (5) sludge heating and gas utilization building; (6) sludge digestion tanks; (7) gas holder; (8) elutriation tanks; (9) sludge disposal building; and (10) administration building. Photo is courtesy of International Harvester Co., whose equipment was used in construction.

NEW YORK'S
ASPHALT RESURFACING PRACTICE

HARRY W. LEVY
Deputy Chief Engineer, Commissioner of Borough Works of Manhattan

The Borough of Manhattan's 500 miles of streets are completely paved. This paving consists of approximately four million yards of granite block and over twice that amount of sheet asphalt. Asphalt pavements generally last from fifteen to twenty years, and then are replaced by contract or resurfaced by the highway maintenance forces.

The resurfacing season starts in the spring and ends in the fall. Streets are selected for resurfacing on the basis of a field inspection made during the prior winter season. Resurfacing operations are carefully scheduled in advance of street operations and the program is staged to fit local requirements for street uses. On some streets contract work must be done ahead of the resurfacing operation where recurbing, drainage or utility installations are involved.

Procedure in Resurfacing

When the resurfacing program gets under way, the normal-size asphalt repair gangs, which usually number some twelve men, are doubled up to compose the resurfacing gangs. Four of these gangs are employed at the height of the resurfacing season and each of these is supplied with a large 8 x 8 surface heater, rollers, trucks, and other equipment. A mechanical spreader —which we do not have—would be a welcome addition to our equipment.

Hot top resurfacing material is supplied by the Manhattan Municipal Asphalt Plant which has a central location in the borough at 90th Street and the East River. The rated capacity of this plant at present is 700 tons per day, but on a recent 'quickie' job done on Fifth Avenue, under forced draft it furnished 1,140 tons over a 10-hour day. An all-time high in tonnage and yardage was laid by the highway maintenance forces on that day in resurfacing the roadway of this important avenue where the work had to be done over a weekend when traffic was light.

● ***SURFACE heater loosening up the asphalt for patching.***

Preceding actual resurfacing operations, sometimes by many weeks, is the resetting of manhole heads. Generally, these are raised slightly to fit the finished crown, and as this seldom exceeds ¾ inch it does not interfere with the constant use of the street by traffic.

The resurfacing operation itself is standard practice whereby the old asphalt surface is heated and scraped with long-handled rakes partially to remove and scarify it. The new hot material is then brought in by truck, hand spread and rolled, and the street opened, usually within three hours.

The Traffic Problem

A most important part of the operation is staging it to cause least interference with traffic. Most of Manhattan's streets are chock-a-block full of vehicles, particularly during the daily working hours. Weekend resurfacing operations are generally impracticable because the Asphalt Plant crews and street crews are not readily available for operations over weekends without interference with scheduled work. Consequently, every effort is made to carry on the resurfacing operations during the normal working day and to arrange

● ***ANOTHER STEP in the endless job of repairing streets.***

the work so that, if necessary, only part of the roadway is done in one operation while traffic is using the remainder. For the most part, particularly on Manhattan's one-way narrower 60-ft. crosstown streets (30-ft. to 34-ft. roadways), which comprise the major portion of the streets in the borough, we have no difficulty in arranging the resurfacing work so that the full width of the roadway is done in one operation. Working from one end of a block, access and egress are permitted from the other end; and as the resurfacing proceeds through the block, traffic shortly follows on the new surfacing. The procedure on the two-way 100-ft. crosstown streets and avenues differs in that we are usually restricted to resurfacing only half the width of the roadway at one time, and traffic is detoured around the operation. This requires close cooperation of the Police Department.

In normal years we do from 250,000 to 300,000 square yards of resurfacing work. The public seems appreciative of this efficient and economical means of overhauling pavements as we seldom receive complaints about it. On the other hand, on small cut work the complaints are numerous.

Recently, we embarked on a project of resurfacing streets where abandoned car tracks are located rather than going to the expense and annoyance of removing the rails. Where carefully done, the results of this are excellent.

OIL MAT RESURFACING FOR IMPROVED STREETS

JOHN R. HAMMAN,
City Manager, Chickasha, Okla.

The oil-mat street resurfacing being carried on here in Chickasha, is not a resurfacing job, but rather a treatment of unimproved earth streets. Some fifteen years ago this practice was begun in this community, with the property owner paying for the material at the refinery and the City transporting the asphalting material, furnishing the equipment and placing the same. This program has been carried on through the years and has been intensified since the close of World War II—with some four hundred blocks being placed from that time until the present. The soil of our streets is sandy loam in nature and is prepared by causing the grade lines to conform in a random fashion with the adjacent property by the excavation or adding of materials during the winter months.

When the oiling season begins, which is normally around June 15, enough of this surface material is windrowed with the motor grader to provide for approximately three inches of oil mat, including the ditch line. The material is hauled in a distributor type tank from the refinery—a distance of approximately forty miles—and when it arrives on the job the material is still warm enough to place without any artificial heating and is manipulated into the native soil windrow by the use of a motor grader and a small 48-in. Seaman Pulvi-Mixer. After the material is thoroughly mixed it is bladed into place and traffic is permitted to travel the street with the effect that the compacting and sealing of the surface is accomplished by normal travel of vehicles. In a very short time this surface completely seals itself and if the drainage is proper, provides fairly good all-weather surface with an average life of six years with a minimum amount of patching.

The material for patching is mixed in a like manner in a windrow and hauled into place and packed by the use of the truck delivering the material to the patching area. The type of oil material used for this work is a heavy asphaltic oil, known as road oil in this area, and might be compared to what is known in the oil industry as D6 heavy fuel oil. Of course, the higher content of asphalt is the governing factor in the amount of gallonage used per block—generally speaking, 2000 gallons of this oil is used per city block of average length—350 feet—and at the present time cost for the material is $125 per block.

This has proved to be a rather satisfactory cheap surfacing plan but certainly has its drawbacks, the main one being that the average citizen expects too much from the completed oil mat job and in some instances residents have been unreasonable in their expectations of repair and patching by the city, which in turn has made it necessary for the City Street Department to adopt a policy of converting the worn out oil mat streets back to their original state by scarifying and blading. A very small percentage of the total only has had to have this treatment but quite often it is necessary for the Street Department to inform the adjacent property owners that this action is going to be taken before much effort is put forth on their part to provide the funds for a reoiling job. The effect of this street oiling program on the general street improvement has not been good, as it has created a very marked tendency to provide for this type of street in residential areas where a more permanent type of surfacing should have been built.

● ***THIS Seaman mixer, similar to the one mentioned in this article, is working on street improvements elsewhere.***

REMOVAL AND DISPOSAL OF SCREENINGS AND GRIT

S. L. TOLMAN,
Manager of Sales,
Sanitary Engineering Division,
The Jeffrey Manufacturing Company

IN all sewage and waste treatment plants, large or small, the sewage should first pass through screens of some type in order to remove those solids, which because of size or nature, may, if not removed, clog pumps or stop pipe lines. Since these solids are removed only because they are oversize, the logical way to dispose of them is to disintegrate them to small size and return them to the sewage.

Screens may be classified as to the size of the installation as follows:

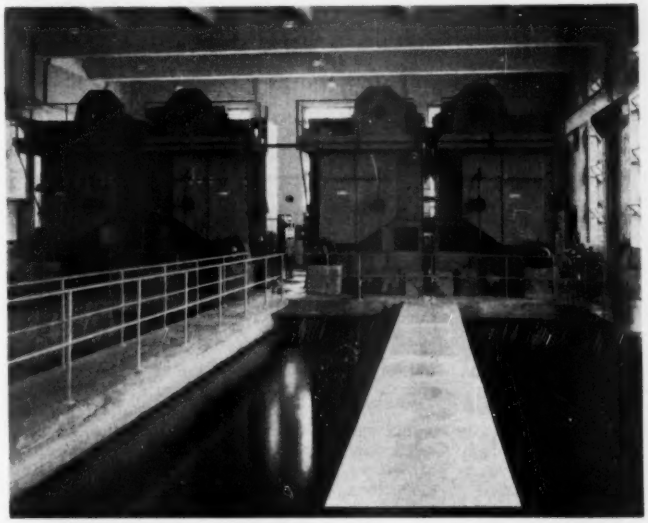
Small plants with sewage flow up to 5 mgd;

Medium plants with sewage flow of 5 to 15 mgd; and

Large plants with sewage flow of 15 mgd and up.

Although hand cleaned screens are sometimes used in the smaller plants, mechanically cleaned screens are recommended for the following reasons: (1) Smaller concrete structures are required; (2) There is little loss of head in a mechanically cleaned screen; there will be little backing up in the sewer, and no deposition of solids in it; the sewage passes through the plant more uniformly as surges in flow are eliminated when screens are kept clean; (3) Since screen bars are left clean, the amount of screenings is reduced, thus lessening the problem of disposal; (4) Mechanical removal of screenings relieves the operator of a disagreeable task, permitting him to be used to better advantage elsewhere in the plant; and (5) Overflows of sewage at the plant are avoided as sewage is never backed up at the screen.

Screens are usually one of two types. The first, known as a comminutor, is of the vertical drum type equipped with cutting elements for cutting up the screenings under water. The second is the mechanically cleaned bar screen, of which there are many satisfactory designs on the market today.



● ***MODERN grit removal installation: A Jeffrey combination scraper, conveyor and V bucket elevator is shown herewith.***

Types of Screens

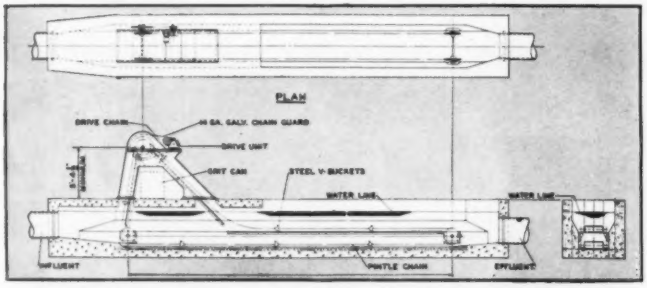
A mechanically cleaned bar screen can be installed in a channel only slightly wider than the incoming sewer and with a bottom elevation near, or slightly lower than, the invert of the sewer. These screens may be of the vertical type for deep installation or inclined for channels of moderate depth. They can be equipped with one rake, or with several; the larger the number of rakes, the less often it is necessary to operate them, thus reducing the operating and maintenance cost of the mechanism. Also, designs are now available for both front and back raked types of screen cleaning mechanism. The latter are now coming into quite common use. This back-raked type is the most dependable ever offered as it is almost impossible to jam the rakes at the bottom of the channel.

For small or medium size plants, the front cleaned screen is recommended. This is an inexpensive screen and can be shipped to the job site completely assembled, ready for installation. For all other plants, whether handling separate or combined sewage, the back cleaned type screen is recommended. This type, because of its size, usually must be shipped knocked down to be assembled in the field.

In all large plants—35 mgd or more—it is common practice to provide two screens operating in series. This permits the very large

solids to be removed by the primary screens which must be built of a design which will stand up under the most severe conditions prevailing during storms. The secondary screens, which are of a lighter design, will have to remove only the smaller solids which can be disposed of by grinding with little trouble. The primary, or coarse, screen has 2-inch to 4-inch openings between the screen bars, while the secondary screen usually has bar openings of ¾-in. to 1-in. The coarse screens remove primarily the large inorganic solids often found in combined sewage during storm periods. They can be removed and disposed of with a minimum of nuisance.

Coarse screens may be manually or mechanically cleaned, but the latter procedure is used in all modern plants.



● ***TYPICAL arrangement of Jeffrey V-bucket type grit collector.***

Design Factors

The screen channel should be designed so that the velocity at maximum flow should be about 3 fps and not less than 1.5 fps at average flow. The high velocity is essential during storm flows to keep heavy grit from depositing on the screen channel floor. Velocities at average flow may be lower, as during these periods the grit load is not great and, as it is usually much finer, it passes through the screen without causing any trouble.

Assuming that the screen is at the end of an interceptor, the bottom of the screen channel will be slightly lower than the invert of the sewer and of such a width that velocities are maintained as outlined above. For practical reasons, mechanically cleaned screens are seldom made with smaller widths than 18 ins. or 24 ins. As a rule, it is good practice to recess the side walls 4 ins. to 6 ins. for the screen guides so that the screen opening will be the same width as the channel. With the usual size of screen bars, the velocity through the bars will be about 3½ to 4 fps. This is not objectionable and will insure all grit passing through the screen.

Disposal of Screenings

In small plants, screenings removed by the rake are disposed of by means of burial, incineration, or disintegration in grinders and discharge back into the sewage, either in front of or behind the screen. These pulped screenings from grinders pass on to the primary tank where the settleable solids are removed with the primary sludge. Any floating material is removed with the scum from the surface of the tank. This method of screenings disposal is in common use today because of its many advantages.

There are many types of screenings grinders on the market today, but one of the best examples is the Jeffrey screenings grinder. This consists of a large number of thin heat-treated steel cutting blades with four cutting edges which travel at approximately 12,000 fpm peripheral speed. Water is introduced into the top of the machine in sufficient quantity to flush the pulped screenings through the screen bars. Most grinders are equipped with metal catchers to prevent damage to the machine. This type of machine is not designed for shock loads and should be fed at a uniform rate in order to obtain best results. When properly operated, such grinders will produce extremely low operating and maintenance costs over a long period of years.

Grinders for Mechanical Screens

Screenings from mechanically cleaned screens are usually discharged onto a picking table from which non-grindable material is removed by hand and then the remainder is hand raked into the grinder. This is an economical and satisfactory arrangement in most plants, especially the small ones, where, except during storms, the screenings can be ground in a few minutes' time on each shift. In large plants, the screenings may be discharged onto a belt or spiral conveyor and allowed to accumulate to a predetermined volume, at which time the belt conveyor and grinder are started and are run until all the screenings are exhausted. In this case, the belt or spiral acts as a feeder to the grinder. The feeder and grinder must be electrically interlocked so that the grinder is allowed to start and reach its maximum speed before the belt is started. Also, at the end of each operation, the grinder must run about 1 minute after the belt stops. This layout is not recommended in the small treatment plant. Except in plants located in the South where the temperature rarely ever reaches freezing, the screen and grinder should be placed inside of a house provided with heat in the wintertime to keep the temperature in the room at all times above freezing.

Operation of Screens

Screen rakes may be operated continuously or intermittently, but the latter is better because it usually reduces operating and maintenance costs. Normal design provides a selector switch so that the cleaning mechanism can be operated on time cycle during normal time, or continuously during storms. In place of the time cycle control, a differential device can be used to start the rake mechanism when a predetermined loss of head through the screen has been reached, and to stop the rakes when the loss of head has reached a minimum. An alternate plan used with time cycle control is to provide a high level float switch which overrides the time control to start the rakes whenever a dangerously high water level is reached in the screen channel ahead of the screen and con-

tinues the operation of the rakes until normal levels have been reached.

Grit Removal

The second step in the pretreatment process is the removal of the grit from the sewage before passing it to the treatment plant. This is done to prevent deposits of sand and silt in the settling tanks, aerators, filters and digesters. Grit channels should be included in every plant, whether small, medium or large and whether handling separate or combined sewage. It is imperative that whenever grit is to be removed by mechanical means, screens must precede the grit channel. Sewage contains rags and other stringy material. This must be removed by screens or it will collect on the mechanical grit removing equipment.

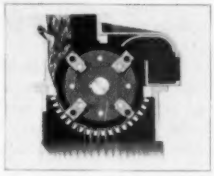
Grit channels usually consist of concrete tanks designed to retain the sewage for a sufficient length of time to remove the inorganic grit or sand. The customary separation is at 65-mesh and all smaller grit is allowed to pass on to the plant. This means that all sand particles of 0.2 mm. in size and over will be removed and all finer sand particles will be carried through the channel. The amount of minus 65-mesh sand in most sewage is so small that this material does not cause trouble in the rest of the plant, although there may be special cases where the removal of finer grit is desirable and the grit channels can be designed accordingly.

Design of Grit Channel

The design of grit channels is based on the area of the channel. Each square foot of area will remove the 65-mesh silica sand from a flow of 40,000 gpd in that portion of the channel where quiescent streamline flow has been established. This requires careful design to insure that inlet and outlet conditions do not lessen the efficiency of the grit channel proper. Also, if the channel is equipped with grit removal equipment that elevates the grit through the sewage flow, it is essential that, at this point, horizontal velocities are not excessive unless the elevator can be enclosed, which is not always practical. In the case of certain types of elevators, velocities in excess of 1 fps will wash most of the fine grit out of the buckets.

In the design of rectangular grit channels, tapered inlets and outlets should be provided to insure quiescent flow through the main portion of the channel. For large plants, these channels can be equipped with one or more scraper conveyors which will convey the grit to a sump from which it is continuously removed, dewatered, and elevated to a storage bin. In large plants, grit channels can be of any width and length. However, in small plants, grit channels should not be less than 36 ins. wide as it is almost impossible to put machinery into narrower channels. The length of the channel should be at least 20 feet; and can be of any length to suit local conditions, though channels over 100 feet long are rarely used. These channels can be round, square or rectangular in shape, and deep or shallow, depending upon local conditions, but the principles of design are the same.

By far, the majority of grit channels built today utilize mechanical removal of the grit. In the case of rectangular grit channels horizontal velocities usually range from 0.75 to 1.25 fps. Theoretically, these velocities should settle out the 65-mesh silica sand, but not move it along the bottom; and at the same time should transport organic particles of 1.6 mm. in size, or less. This would result in satisfactory grit from such as design if all the organic solids were 1.6 mm. or smaller. Unfortunately, this is rarely the case so that grit from such channels may contain organic matter. This can be removed only by a grit washer. Though proportional weirs, Parshall flumes, or similar devices are used to control the velocity through the grit channel, grit rarely can be disposed of without nuisance unless washed.



● ***ESSENTIAL parts of Jeffrey grinder, see opposite page.***

Grit Channel Equipment

Collectors for grit channels are usually one of the following types: (1) V bucket type; (2) Scraper type; (3) Combination of scraper and inclined spiral; (4) Combination of spiral and bucket elevator; (5) Combination of scraper and V bucket elevator; or (6) Revolving type.

For small and medium size plants, the equipment to use is (1), (2), (3), (4), or (6). For large plants, use (1), (2), (3), (5) or (6). In all cases, local conditions will influence the selection of the equipment. The scraper type can be used to advantage in installations where the flow line is relatively near the ground level, but the V bucket type, or the spiral and elevator type, is suitable for deep channels. The V bucket type is used with a long narrow channel, and the spiral and elevator type where space does not allow a long channel.

The amount of grit to be handled by grit removal mechanisms will vary from 2 to 3 cu. ft. per mg during dry weather conditions, to as much as 54 cu. ft. or more per mg during storms. The topography of the area served, type of paving of streets, grade and velocity of sewage in the interceptor bringing the sewage to the plant, will all influence the grit load and how it may be expected to arrive at the plant. Normally, grit removal devices are calculated to remove grit continuously at the highest rate it is anticipated to arrive at the plant. It is for this reason that the design engineer should give all the local facts to the machinery designer so that the equipment may be capable of operating under all conditions. Also, all unusual conditions should be considered, such as special industrial wastes and the extent to which they will affect the quality of the sewage and quantity and quality of grit.

Grit Washing

Various types of partial washing devices are possible, such as recirculation of grit during periods of low flow, passing the grit before removal through a zone where the velocity is relatively high and spraying the grit with clean water

(*Continued on page 96*)

DESIGN DATA AND EQUIPMENT for SEDIMENTATION

J. J. GILBERT,
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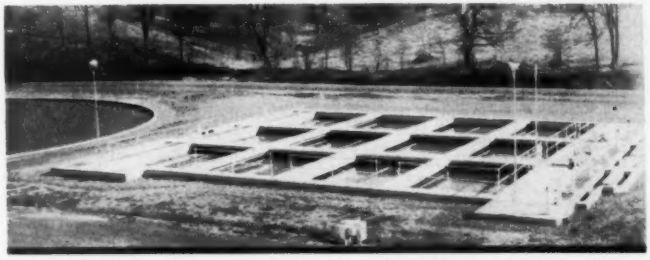


● *THREE primary settling tanks at the Winchester, Va., plant.*

SEDIMENTATION is the process by which suspended matter in sewage settles by gravity to the floor of a tank as "sludge." It also involves the separation of floating solids and oils or greases on the liquid surface as "scum."

Primary sedimentation is the most economical means of sewage treatment as more solids will be removed per dollar of construction and operation costs than by any other method. Secondary or final sedimentation, following biological treatment by trickling filters or activated sludge, removes solids which have been developed in these processes. Here again sedimentation is the most economical method.

The major objectives to be accomplished in sedimentation tanks are: (a) Removal of the settleable suspended solids; (b) production of a sludge with maximum solid content; and (c) operation without the creation of objectionable odors.

Types of Sedimentation Tanks

Many types of sedimentation tanks have been built—flat bottom, hopper bottom, single story and double story tanks. However, during the past thirty years mechanical sludge collectors have been developed and improved so that present day practice demands that all tanks, except the very smallest, be equipped with these sludge collectors. Sludge collector equipment can be installed in square, round or rectangular tanks. In each type of tank the mechanism moves the settled solids or sludge along the floor of the tank to a sludge hopper and the floating solids or scum to a scum trough.

Sedimentation tanks are used in the following types of plants: (a) Primary treatment plants for primary settling only; (b) chemical treatment plants for primary settling and coagulation of sewage solids and chemical floc; and (c) secondary treatment plants, for primary settling prior to trickling filters and activated sludge aeration tanks; and (d) for final settling following trickling filters and activated sludge aeration tanks.

Design Factors

A few State Boards of Health have published standards for the design of sewage treatment plants. The engineers of other states prefer to consider each project on its own and then establish the design factors. The published standards vary from state to state so only average factors will be given in this article. In every case preliminary designs should be discussed with the State Sanitary Engineer to obtain approval of the basic design factors prior to proceeding with the final design.

Flow.—The size of the sedimentation tank depends on the flow of sewage through the tank. Where the actual flow cannot be measured it is usual practice to assume an average daily flow of 100 gallons per capita, to which must be added the industrial waste flows. If the actual daily flow is determinable, the sedimentation tank is designed for the average rate over the 16 peak hours. Provision must always be made for population and industrial wastes increases for the next 15 to 25 years.

Where recirculated flow from a filter or returned activated sludge passes through a tank its capacity must be increased in proportion.

Detention.— Most modern sedimentation tanks are of the continuous flow-through type. Batch or fill-and-draw tanks are used only at small industrial installations. Tests at full scale installations indicate that the actual detention period is 1/3 to 1/2 of the theoretical detention period.

The velocity through a sedimentation tank is not usually figured in present day practice. The detention period, surface area, economical depth, and ratio of tank length to width, together with sludge collection equipment requirements, automatically take care of this factor.

The allowable (theoretical) detention period for sedimentation tanks varies from 1 to 3 hours. The lower detention period is used as preliminary treatment for activated sludge plants and for final treatment following a standard rate trickling filter. A two hour detention period is sufficient for most sedimentation tanks. However, a three-hour detention is required by some states where only primary treatment is provided or where practically all the flow reaches the plant in 16 hours, as at a small installation.

The detention period is based on the volume of the tank above the sludge hoppers in the case of rectangular tanks. For round tanks the

side water depth at the periphery is used to calculate the tank volume, the volume in the sloping bottom section being neglected.

Sedimentation Tank Size

The required volume of a sedimentation tank is calculated from the detention period and the design flow. The two factors affecting the dimensions of the tank are the economical depth and the allowable surface settling rate. The water depth should not be less than 6 feet. Usually the most economical construction results from a water depth of 8 to 10 feet. At large installations a water depth of 12 to 14 feet has been used.

The allowable surface settling rate for a sedimentation tank varies according to the size of the plant, type of treatment and the type of tank. Suggested maximum surface settling rates are, in gallons per sq. ft. per day: Primary sedimentation only, 600 to 900. Primary sedimentation prior to secondary treatment, 900 to 1200. Final sedimentation after trickling filters, 1000; after high rate filters, 900, and after activated sludge, 800.

Actually the surface settling rate is a function of the detention period and is determined by the water depth in the tank. Table 1 shows the relation between water depth and the surface settling rate for various detention periods.

From the table it can be seen that for tanks over 14 feet deep the surface setting rate for 2-hour detention increases beyond the maximum allowable.

For rectangular tanks the length should be 3 to 5 times the width. A minimum diameter of 30 ft. for round tanks is desirable in order to provide proper distribution and sufficient travel of the sewage before reaching the effluent weir, though many round tanks of less diameter have been installed.

● ***FINAL settling tanks at Dayton, O., are Circuline equipped.***

Design Problem

To select the dimensions for a primary sedimentation tank for a flow of 1 mgd, with 2 hours detention, the flow volume, 1 mgd, is multiplied by the detention time in hours, 2, and divided by 24 hours times the number of gallons in a cu. ft., 7.5. This gives the tank volume, 11,440 cu. ft. Using two tanks, so one will be in operation in case servicing or maintenance is necessary, the volume of each will be 5,570 cu. ft. With an overflow rate of 900 gals/sq. ft/day, the tanks will be 10 ft. deep. Using the normal length/width ratio of 1 to 4, rectangular tanks will be 12 ft. wide and 47 ft. long.

Using round tanks, and assuming a diameter of 30 ft., the surface area of each tank will be 707 sq. ft; and with a sidewater depth of 8 ft., the overflow rate will be 720 gals/ sq.-ft/day.

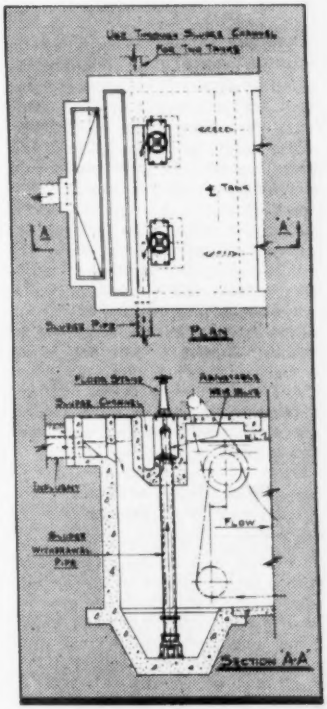
In this case, considering the cost of the tank and of the sludge collector mechanism, the rectangular tanks will be less costly to construct. Rectangular tanks will generally cost less to construct than round tanks of equal volume if the required diameter of the round tank is less than 60 ft. Round tanks larger than 60 ft. in diameter will usually cost less than rectangular tanks of equal volume.

Construction Details

INLET.—Feed pipes to sedimentation tanks should have a minimum velocity of 2.0 feet per second to prevent the deposition of solids in the pipes. However, where open top inlet channels are used they should be designed for lower velocities, 1.0 to 0.5 feet per second, in order to keep the entrance velocities low. As many inlet ports as possible should be provided to insure a minimum

TABLE I.—DETENTION AND OVERFLOW RATES

Water Depth in Feet	1-Hour Surface Settling Gals/sq ft/day	2-Hour Surface Settling Gals/sq ft/day	3-Hour Surface Settling Gals/sq ft/day
6	1080	540	360
8	1440	720	480
10	1800	900	600
12	2150	1075	720
14	2510	1255	840



● ***INLET end of rectangular tank showing sludge removal and influent channel design and head end of scrapers.***

velocity and maximum distribution across the full width of the tank or around the center entrance pipe of a round tank.

BAFFLES.—Sedimentation tanks were originally constructed with numerous cross baffles in the belief that if one was good more were better and that they aided in the removal of the settleable suspended solids. However, experience has shown that the highest efficiency will be obtained from a sedimentation tank with one influent baffle and one effluent baffle.

Influent baffles serve the dual purpose of reducing the entrance velocities to a minimum and securing a quiet horizontal flow. They can be constructed in many different forms. The most economical construction is a solid wood baffle with its top 2 ins. below the water surface to prevent scum being trapped between the baffle and the influent ports. The bottom of the baffle should be approximately 12 ins. below the invert of the influent ports. The influent baffle should be located 2 to 3 feet in front of the influent ports.

Effluent baffles are installed for the sole purpose of retaining the floating scum on the surface of the tank and preventing it from going over the effluent weir. The effluent baffle should be located 12 to 18 ins. from the effluent weir and should extend 2 ins. above the water and at least 12 ins., and preferably more, below the water line in order to prevent scum from going under the baffle during the skimming operation. Ample and convenient walkways should be provided at the top of the tank so that the scum can be readily deposited into the scum trough or the revolving scum pipe. Usually the effluent baffles and revolving scum pipe or scum trough are committed from final sedimentation tanks.

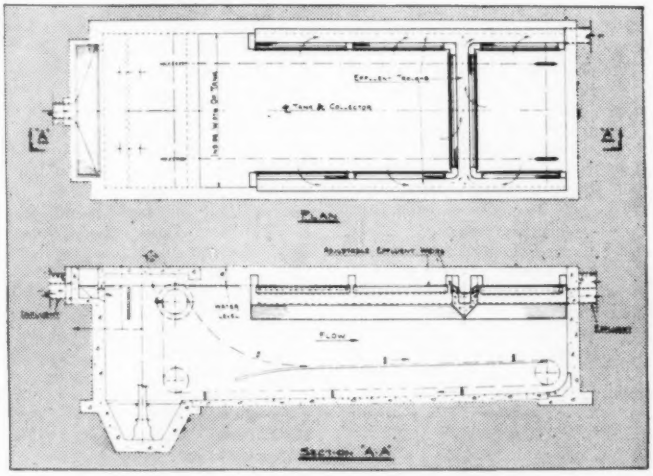
Weir Overflow Rates and Weir Design

EFFLUENT WEIRS.—Every sedimentation tank should be provided with a metal effluent weir. The top edge of the weir should be ground to a straight and true knife edge. Some engineers prefer that the weirs have "V" notches so that the depth of flow over the weir will be deeper, and thus compensate for slight inaccuracies in the leveling of the weir during erection. The effluent weirs should have 2-in. long slotted bolt holes, arranged so that the weirs can be leveled precisely and bolted in place. Care should be taken that these slots do not extend above the supporting angle or wall when the weir is at its highest level. To do so would allow leaking of water through the slotted holes. Weir loading and location have been shown to affect the efficiency of a settling tank. This effect is more pronounced in activated sludge and high rate trickling filter final sedimentation tanks than in primary tanks due to the lighter solids in final settling tank influents. Several State Health Departments now have requirements limiting the maximum overflow rates for effluent weirs. These rates vary from 10,000 to 15,000 gallons per lin. ft. per day. The lower rates are for smaller tanks and final settling tanks.

If the tanks designed above were required to have weirs with an overflow rate not to exceed 15,000 gallons per lin. ft. per day the rectangular tanks would require additional weir length over the one weir at the effluent end of the tank: 1,000,000 ÷ 15,000 = 67 lin. ft. of weir required. Each of the two rectangular tanks 12 feet wide would require three weirs each 12 ft. long. To accomplish this a steel "U" trough with weirs could be installed across each tank about three feet from the weir at the effluent wall.

For the two round tanks 30 ft. in diameter, the overflow rate is 1,000,000 ÷ 189 (the total circumference) = 5,200 gals/lin ft/day.

This does not mean that all circular tanks meet the maximum overflow rate requirements. For a flow of 5.0 mgd. and a 2-hour detention period, one circular tank would require 55,704 cu. ft. volume and would be 85 ft. in diameter with 10-ft. side water depth. The weir length would be 268 ft. and the weir overflow rate would be 18,800 gals./lin/ft/day. Additional weir length can be provided for round tanks by installing "U" troughs with weirs 5 ft. to 10 ft. in from the effluent weirs at the periphery of the tank.



● *ONE of several methods that are available for arranging weirs in a rectangular tank to lower weir overflow rates.*

Removing the Sludge

Sludge Drawoffs.—The solids which settle to the floor of the tank as sludge are conveyed to the sludge hopper by the mechanical sludge collectors. Sludge hoppers should have a volume at least equal to the pump capacity for the period between discharges of the sludge scrapers or flights. The sludge hopper can be smaller where sludge removal is continuous. Ample hopper size will insure a maximum solid content and a uniform sludge

The sides of the sludge hoppers should be on an incline of at least 60 degrees with the horizontal. The bottom of the hoppers should have as small an area as possible, not more than 4 square feet. Sludge draw off pipes should not be less than 6 ins. in dia. where hydrostatic head is used and at least a 4-ft. sub-

(*Continued on page* 94)

ANAEROBIC fermentation has been recognized as the least expensive and perhaps most widely adaptable method of destroying organic matter in sewage or waste liquors. Though it has been normally assumed that the material to be digested should contain at least 1% of organic matter, in order to avoid the necessity for excessive digester capacity, a recent article on anaerobic digestion of meat packing wastes (1) indicates economical operation of a pilot plant with a raw feed containing only 5630 ppm of total solids and about 2000 ppm of volatile matter, which might represent only about 0.2% organic matter in the waste liquor. Thus it is evident that sludges obtained from any sewage treatment process are sufficiently concentrated for digestion.

Even when sludge is to be disposed of by vacuum filtration and incineration, digestion may be helpful. Fischer (2) shows that, regardless of the final method of disposal, it is economically feasible to include digestion. However, in large activated sludge projects, a lower total annual cost may be shown for the vacuum filtration and incineration of a combination of digested primary sludge and thickened undigested activated sludge.

In a study by the writer covering a number of large projects, it was indicated that digestion is economical and desirable, even with filtration and incineration, for the following reasons: (a) The required capacity of filtration, chemical feed and incineration equipment is reduced about three-fourths by the equalizing action of the digester in reducing maximum daily peak contributions of solids and by the 40% to 50% reduction in solids due to digestion; (b) the amount of conditioning chemicals is substantially reduced; (c) sludge handling equipment is reduced very materially because of the lower moisture content and volume of the digested sludge; (d) storage in the digester equalizes the composition of the solids, even if digester capacity provided is one-sixth to one-seventh of that required for full digestion; (e) possibility of odors are reduced; and (f) means are provided for disposal of the sludge without nuisance in case the incinerator is out of service.

On projects of moderate or large size the gas generated by digestion may be used for power production, realizing substantial savings. In addition to the extraction of the full power available in the gas, sufficient heat is obtained for the maintenance of digester and building temperatures from the engine water jacket and exhaust.

Practical Considerations

Despite the fact that digestion has developed into an important and economical part of any sewage treatment process, the design and operation of systems for carrying out sludge digestion have not been given the consideration they deserve. It is the writer's opinion that the digestion process has not reached the degree of perfection of other units of a sewage treatment plant.

If properly designed and operated, the digestion system can serve as a "take-up" in the plant, receiving solids and scum from clarifiers on a schedule favoring their operation; and the solids may be withdrawn from the digesters in amounts and at intervals to suit best a drying bed or incinerator schedule, with the digester still fully effective in performing its major role of destroying organic matter.

The purposes of digestion may be summarized as follows: (a) To produce an inoffensive sludge for disposal, breaking down the organic matter causing putrescibility; (b) to reduce the quantity of sludge to be disposed of through liquefaction, gasification and concentration of the solids; and (c) to produce a sludge that may be dewatered or dried readily, which is accomplished by breaking down the water-binding properties of the sludge. Secondary benefits include (d) production of sewage sludge gas for use as a source of heat, power and revenue, and (e) permitting sludge to be used as a fertilizer.

It is not economically feasible nor desirable to attempt to destroy all of the organic matter in sewage

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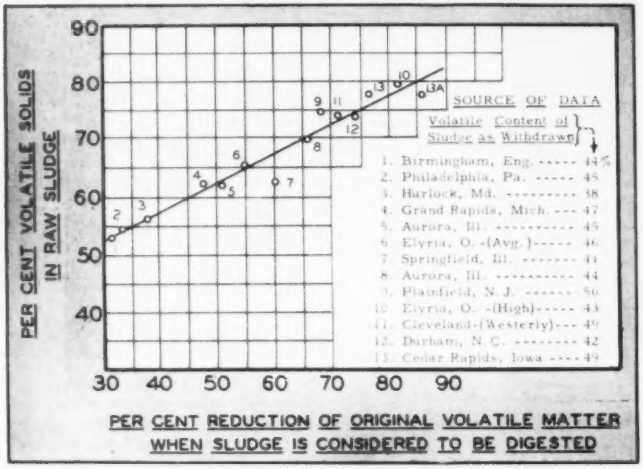
sludges by digestion. With normal domestic sewage sludge, digestion beyond 30 days is beneficial largely for the concentration of the digested solids and the production of a clearer liquor from them. Where vacuum filtration and incineration are employed, much shorter periods of digestion will accomplish a marked reduction in volume of solids.


PER CENT VOLATILE SOLIDS IN RAW SLUDGE
90
80
70
60
50
40
30 40 50 60 70 80 90
PER CENT REDUCTION OF ORIGINAL VOLATILE MATTER WHEN SLUDGE IS CONSIDERED TO BE DIGESTED
SOURCE OF DATA
Volatile Content of Sludge as Withdrawn
1. Birmingham, Eng. ----- 44%
2. Philadelphia, Pa. ----- 48
3. Hurlock, Md. ---------- 38
4. Grand Rapids, Mich. --- 47
5. Aurora, Ill. ---------- 45
6. Elyria, O.-(Avg.)----- 46
7. Springfield, Ill. ------- 41
8. Aurora, Ill. ---------- 44
9. Plainfield, N. J. ------ 50
10. Elyria, O. -(High)----- 43
11. Cleveland-(Westerly)--- 49
12. Durham, N. C. -------- 42
13. Cedar Rapids, Iowa ---- 49

● ***FIG. 1. Percent reduction of volatile matter by digestion as related to percent volatile solids in the raw sludge.***

From a study of the data from a large number of municipal sewage treatment plants it is known that a sludge which is considered to be well digested, in accordance with the particular standards used by the plant operator for each plant, will contain from 40 to 50% volatile matter as determined by the volatile solids test of "Standard Methods".

Figure 1 shows the relationship between the per cent reduction of original volatile matter when sludge is considered to be digested as compared with the volatile solids in the raw sludge, calculated from the per cent volatile solids in the raw and digested sludges for each plant with the assumption that the fixed solids are not changed during the digestion. This assumption has appeared to be reasonable in a careful check of digester inventory records of solids added to digester systems as contrasted to volatile solids accounted for in the digested sludge, in digester liquor withdrawals, and in the gas collected. It has thus been used in the analysis of records of digester operation for many years by the writer. However, the data in a recent article by Waggoner (4) are based upon the assumption that 25% of the volatile matter is converted to ash by digestion. This basis would result in lower values for per cent reduction of volatile matter than shown by the curve of Fig. 1. In the figure, the plotted value "13" for Cedar Rapids, Iowa, is the value obtained from a calculation of the percentage of volatile solids in the raw and digested sludges while value "13A" is obtained from the operating records for a 1-year period ending with March, 1951, based upon total pounds of volatile solids added to the system.

Effect of Biological Action

For greatest effective use of the available capacity of a digester system it is important for the plant operator to realize that digestion is dependent upon the presence and growth of micro-organisms which utilize the organic matter present in the sludge; and that these organisms will produce new cells so long as conditions for their growth are favorable and the food supply is undiminished.

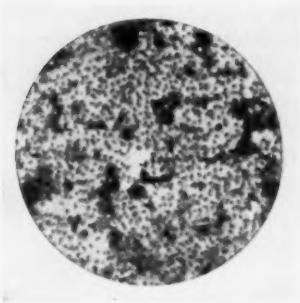
Studies made by the writer in collaboration with Dr. A. M. Buswell of the Illinois State Water Survey, and partially reported by them (5), definitely indicated that a group of bacteria designated as "methane producing organisms" are responsible for the conversion of the carbon and hydrogen of organic matter to methane. Pure cultures of single organisms from this group have demonstrated their ability to produce methane from organic compounds.

Figure 2 is a micro-photograph of a sample taken from the primary digester which receives sludge from a trickling filter at a malt house waste treatment plant. The sample was taken at a time when the gas production from the digester was about four times normal, indicating an extremely high rate of digestion. The micro-photograph shows the presence of a well established bacterial flora of Micrococci, one of the methane producing organisms.

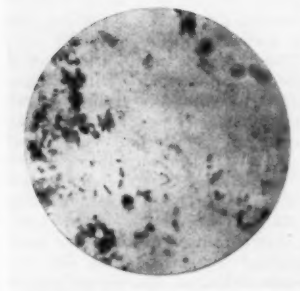
During the same period a micro-photograph, Fig. 3, of a sample taken from a primary digester of a yeast waste plant, indicated relatively few organisms and no particular predominance of any one methane-producing form. At the time the sample was taken the rate of digestion, as indicated by gas production, was approximately one-tenth the normal rate previously established for the amount of feed of organic waste.

It was decided to seed this poorly operating digester with a large tank-truck load of active sludge taken from the digester at the first mentioned installation. With careful control of the temperature and digester recirculation, this resulted in a return to the normal rate of digestion. Figure 4, representing a new sample of the contents of that digester taken a few days after the seeding and the return to a normal rate of digestion, showed an abundant growth of the rod-like forms, the large Sarcina and some of the Micrococci, all forms of methane-producing organisms. It was from this particular sample of digester contents that Dr. Buswell was able to obtain for the first time a purified culture of the large Sarcina form "Methano sarcina".

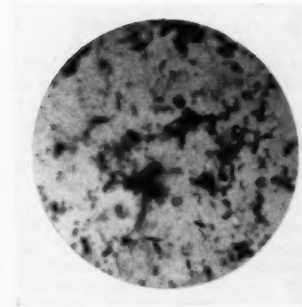
Although it was surprising to find large numbers of the Sarcina form of organisms in the sample, a closer study of the micro-photograph of the sample from the digester providing the seed material, Fig. 2, indicated the presence of Methano sarcina, although the Micrococci were in predominance. This definite relationship of bacterial flora to the successful operation of a digester system, and the special knowledge of methane-producing organisms and their characteristics will be further considered elsewhere.



● ***FIG. 2. Micro-photograph of sample, digestion tank, Jefferson Junc., Wisc., during very high gas production.***



● ***FIG. 3. This shows a sample of digestion tank contents at Crystal Lake, Ill., during period of low gas production.***



● ***FIG. 4. This shows how the Crystal Lake sludge appeared after seeding with sludge containing methane producing organisms. Gas production normal.***

From a practical operation standpoint, the major considerations in proper digester control would include the factors listed below.

It is important for operating personnel to exercise care in withdrawing sludge and in adding fresh solids. Sludge additions should be made to each primary digestion tank as frequently as possible or as may be feasible. By adding smaller quantities at more frequent intervals a more constant food supply is afforded the organisms and a more uniform rate of gas production will be obtained, indicating a more uniform rate of digestion. Raw sludge should have as low moisture content as is possible, since extra liquid added to the digester reduces the effective digestion time, and requires additional heating.

Sludge withdrawals should be made in small increments. When a digestion tank is loaded with solids, with little supernatant liquor present and with a predominance of so-called floating sludge on top, operators will often withdraw a large quantity of the low volatile or best digested sludge from the bottom of the tank. This generally results in aggravating the improper digestion conditions by elimination of the buffering effect of these withdrawn digested solids, resulting in an increase in the floating sludge layer, both thickness and concentration.

In a two stage digestion system care must be exercised in transferring material from the primary or "active tank" to the secondary or concentration-separation tank. The best digested solids should not be depleted since they are necessary not only for seeding and buffering of the added raw solids, but as a "roughage" material necessary for the proper environment for the organisms to work effectively.

Temperature Control

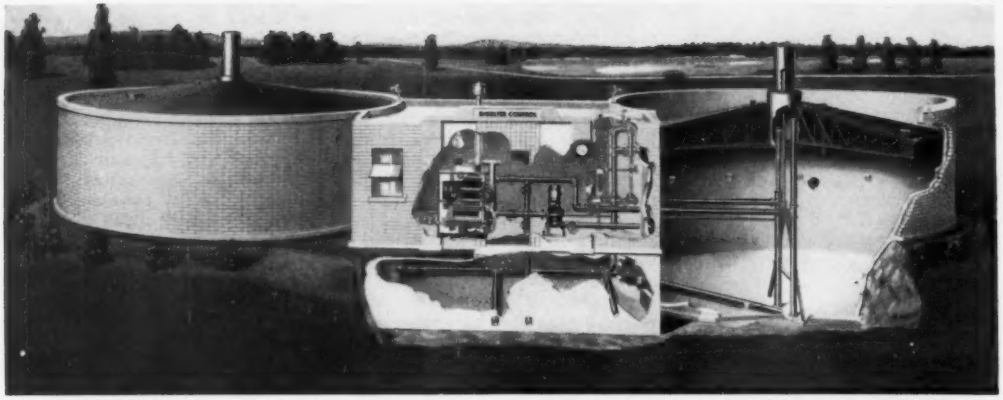
A temperature of 90 to 95°F has been found by most plant operators to be optimum as measured by the rate of gas production and quality of the digested sludge. To be most effective, the temperature must be uniform throughout the entire depth of the digestion tank and should be maintained within a narrow range of a few degrees above or below an established value. In the studies of methane-producing organisms previously referred to it was found that these organisms are quite sensitive to temperature changes, and cannot tolerate rapid variations in temperature without a marked decrease in activity.

Realizing the importance of a close temperature control, and observing that hot water coils immersed in the digester contents are not effective in maintaining temperatures within the limits indicated, the writer in 1945 developed the design of an external heater and heat exchanger for maintaining an optimum and uniform temperature within 1°F plus or minus. Digester contents are recirculated through coils in the heat exchanger portion of the external unit, and are heated as required to obtain the optimum temperature in the digester. Raw sludge when added to the system is pumped into the recirculated liquor where it is intimately mixed with the active material as recirculated, and is heated to the tank temperature before being discharged into the digester. Thus great variations in tank temperature due to raw sludge additions are avoided.

The entire heating is controlled by a sensitive thermostatic bulb located at the inlet to the sludge tubes of the heater and heat exchanger unit, and is dependent upon the temperature of the recirculated digester contents.

Reactions in Digestion

The pH of the ,tank contents should be from 6.8 to 7.2. Ordinarily in a well designed and operated digestion system it is possible to maintain a balance between fresh and digesting solids so that the reaction will remain within these limits. Liming is often used to correct a low pH, but recent experiences of the writer suggests the revolutionary statement that "lime in any form has no place in a digester". In view of the divergence of opinion in regard to liming of digester contents, as related in an operators' forum discussion (6), the above statement might be modified to say that lime has been greatly misused in the control of sludge digestion to the extent of being detrimental in as many instances as it has been beneficial in other instances.



● ***PHANTOM** view of two-stage digester system showing piping arrangement for external heating.*

It is the writer's contention that the proper pH reaction is the result of satisfactory digestion conditions and that a correction of the pH by adding an alkali will not necessarily result in improved digestion conditions.

Volatile Acids Control

Volatile acids control has been employed successfully to foretell the approach of retarding digestion conditions at a number of municipal and industrial waste installations with digesters operating at higher than normal loadings. In fact, to digest most industrial wastes successfully it has been found to be absolutely necessary to practice volatile acid control. This involves a simple determination, now included in the latest issue of "Standard Methods", (3) which easily may be made daily to provide a "warning" long before a change of pH, alkalinity, drop in rate of gas production, or foaming would indicate that trouble is at hand.

In practice, if the volatile acids determination indicates a concentration of, say, 2,000 ppm in a sample taken from a digester, or if succeeding determinations indicate a continued rise in the concentration of volatile acids, either of the following steps must be taken:

(i) Reduce the loading of raw solids in the digester showing the increase by diverting some of the raw solids to another digester in the system; or

(ii) Circulate lower volatile acid content material from a second stage digester to the overloaded primary digester. As a result, a more rapid gasification takes place and the volatile acids are reduced much more than can be accounted for by mere dilution.

An interesting substantiation of "Volatile Acids Control" is contained in a recent article by Dr. A. M. Buswell and F. W. Sollo, Jr. (7), in which radio-active carbon was used as a tracer in controlled digestion experiments. The results reported in this article were further confirmed by duplicated experiments of expanded scope as reported by T. C. Stadtman and H. A. Barker. (8)

Anyone interested in the "Mechanism of Methane Fermentation" would do well to read and study the above two references. These indicate the relationship which exists between accumulation of high concentrations of volatile organic acids in a digester and the slowing down or complete cessation of digestion activity which invariably accompanies or closely follows such high concentrations.

Control of Scum

The formation of any considerable amount of scum in a digester should be avoided. Such material consists of "layover" slowly digesting solids which take up effective digestion space and constitute a zone of high substrate concentration in which a high concentration of acids is likely to develop.

Scum formations may be prevented or, if present, may be dispersed by the discharge of heated recirculated digester liquor at the surface of the digesting mass, using a discharge pipe terminating at the normal high liquid level at the center of the digester as shown in the "phantom view" of a digester system. The moistening of the scum mass, the heating of the scum, and the bringing of active organisms in contact with the scum causes it to digest rapidly and disappear. The control of scum in digesters is more completely covered in two articles by the writer. (9) (10)

The periodic addition of small amounts of ammonia nitrogen-containing solutions, as from ammonium sulphate or ammonium nitrate, to the digester liquor recirculated to the scum zone have been shown to be beneficial in dispersing heavy scum accumulations which do not yield to digester recirculation alone. Rather conclusive results have been obtained by the addition of ammonia nitrogen at a number of plants where scum accumulations in the digesters have been excessive (11).

Other Considerations

Many plant operators have been inclined to consider "foaming" as a mysterious phenomenon associated with sludge digestion in Imhoff tanks and separate digesters. It is the writer's opinion (12), that foaming is merely the result of violent activity in a digestion tank due to a "layover" of solids, all of which start to digest at one time. This is the case when a cold digester full of solids is heated for the first time. It has been found that, by a recirculation of the digester contents at such a time, it is possible to reduce the expansion of the tank contents and prevent the overflow of gas-lifted floating solids, effecting a release of the gases thus entrained.

The importance of the control of supernatant is primarily related to its effect on the other units of the treatment process. In a normal

operating digester this problem is easily overcome by selecting a supernatant liquor lowest in suspended solids for removal from the digestion system and withdrawing it at a continuous and slow rate.

The use of digester liquor in a beneficial manner is one of the most important developments of the past few years. L. S. Kraus of Peoria, Ill., has perfected and described a precedure (13) (14), which involves the utilization of the organic and ammonia nitrogen content of the digester liquor for the production of nitrites and nitrates. It is accomplished by drawing the digester liquor, togther with a portion of the return activated sludge, to an aerated basin. The high concentration of nitrites and nitrates which are formed in this nitrifying unit is beneficial in controlling bulking in the activated sludge process, corrects a faulty sludge index and balances the concentration of solids in the mixed liquor.

The return of digester liquor directly to the trickling filter has shown startling results in reduction of BOD at the malt house waste treatment plant at Jefferson Junction, Wisc. The digester liquor, withdrawn at a uniform rate, and secondary sludge are mixed and aerated in a small basin. The resulting nitrified material is continuously added to the feed to the trickling filter.

Besides increasing the efficiency of the trickling filter as measured by BOD reduction, the addition of the nitrified digester liquor and secondary sludge solids tends to produce a more uniform unloading of solids from the filter bed and eliminates any tendency for filter ponding. This result, contrary to what might be expected in adding an appreciable solids load to a biological bed, is due to the rapid oxidizing effect of the nitrified material.

Designing For Proper Control of Digestion

It is important that the consulting engineer in designing the sludge digestion system provide, in the original layout, a proper arrangement of piping, valves, pumps and devices to allow the flexibility necessary for the plant personnel effectively to carry out operational control measures.

The volumetric capacity required in the digestion system should be carefully determined so that sufficient volume is available for effective digestion. It is not economically feasible, from a first cost standpoint, to provide an excessive volume in the digestion system, nor is an excessive capacity necessarily desirable from the standpoint of improved results. It has been found that where the plant operating personnel is confronted with a digester system which is not liberal in its capacity, a closer control of the system is maintained.

In many cases State Boards of Health have set up requirements for the capacity of the digestion system based on data from, and experiences with, poorly operated treatment plants, even though better digestion results would have been possible with a more careful operational control of what might have been improperly considered as an inadequate digester capacity. An article by R. S. Rankin (15) provides an interesting survey of digester capacity requirements and discusses various "yard sticks" for establishing the volume required for digestion.

Table I is a tabulation of the relationship between various methods for expressing the loading of solids in digesters, the capacity in terms of per capita allowances, and the displacement time on the basis of wet raw solids added. Normal factors for the pounds of solids expected per capita, removals of solids

(*Continued on page* 98)

RAW SOLIDS LOADING (Pounds)					DIGESTER CAPACITY PROVIDED IN CUBIC FEET PER CAPITA (Basis of 0.20# Total Suspended Solids in Raw Sewage Per Capita.)			DISPLACEMENT TIME IN DAYS (Basis of Raw Sludge Added at the Indicated Moisture)		
TOTAL DRY SOLIDS		VOLATILE DRY SOLIDS (Assumed as 70% Volatile)								
Per Cu. Ft. Per 30 Day Period	Per Cu. Ft. Per Day	Per Cu. Ft. Per 30 Day Period	Per Cu. Ft. Per Day	Cu. Ft. Per Lb. of Volatile Added Per Day	Primary Settling @ 60% Removal	Trickling Filter @ 90% Removal	Activated Sludge @ 95% Removal	Primary Settling 95% Moisture	Trickling Filter 96% Moisture	Activated Sludge 97% Moisture
0.30	0.010	0.210	0.0070	143.0	12.00	18.00	19.00	312.5	250.0	187.5
0.45	0.015	0.315	0.0105	95.2	8.00	12.00	12.70	208.2	166.6	125.0
0.60	0.020	0.420	0.0140	71.4	6.00	9.00	9.50	156.3	125.0	93.8
0.75	0.025	0.525	0.0175	57.2	4.80	7.20	7.60	125.0	99.9	75.0
0.90	0.030	0.630	0.0210	47.6	4.00	6.00	6.30	104.1	83.3	62.5
1.05	0.035	0.735	0.0245	40.8	3.43	5.14	5.43	89.3	71.3	53.6
1.20	0.040	0.840	0.0280	35.7	3.00	4.50	4.75	78.1	62.5	46.9
1.35	0.045	0.945	0.0315	31.7	2.67	4.00	4.22	69.5	55.6	41.7
1.50	0.050	1.050	0.0350	28.6	2.40	3.60	3.80	62.5	50.0	37.5
1.65	0.055	1.155	0.0385	25.9	2.18	3.27	3.45	56.8	45.4	34.1
1.80	0.060	1.260	0.0420	23.8	2.00	3.00	3.16	52.1	41.6	31.3
1.95	0.065	1.365	0.0455	22.0	1.85	2.77	2.91	48.2	38.5	28.8
2.10	0.070	1.470	0.0490	20.4	1.71	2.57	2.71	44.7	35.7	26.8
2.40	0.080	1.680	0.0560	17.8	1.50	2.25	2.37	39.1	31.3	23.4
2.70	0.090	1.890	0.0630	15.9	1.33	2.00	2.11	34.7	27.8	20.8
3.00	0.100	2.100	0.0700	14.3	1.20	1.80	1.90	31.3	25.0	18.8
3.30	0.110	2.310	0.0770	13.0	1.09	1.64	1.73	28.4	22.8	17.5
3.60	0.120	2.520	0.0840	11.9	1.00	1.50	1.58	26.0	20.8	15.6
3.90	0.130	2.730	0.0910	11.0	0.92	1.38	1.46	24.0	19.2	14.4
4.20	0.140	2.940	0.0980	10.2	0.86	1.29	1.36	22.3	17.9	13.4
4.50	0.150	3.150	0.1050	9.5	0.80	1.20	1.27	20.8	16.7	12.5
4.80	0.160	3.360	0.1120	9.0	0.75	1.13	1.19	19.5	15.6	11.7
5.10	0.170	3.570	0.1190	8.4	0.70	1.06	1.12	18.4	14.7	11.0
5.40	0.180	3.780	0.1260	7.9	0.67	1.00	1.05	17.4	13.9	10.4
5.70	0.190	3.990	0.1330	7.5	0.63	0.95	1.00	16.5	13.2	9.9
6.00	0.200	4.200	0.1400	7.2	0.60	0.90	0.95	15.6	12.5	9.4
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

● ***TABLE 1. Relationship between digester loadings (pounds of raw solids), digester capacity provided in cubic feet per capita, and raw sludge displacement time in days.***

ACTIVATED SLUDGE

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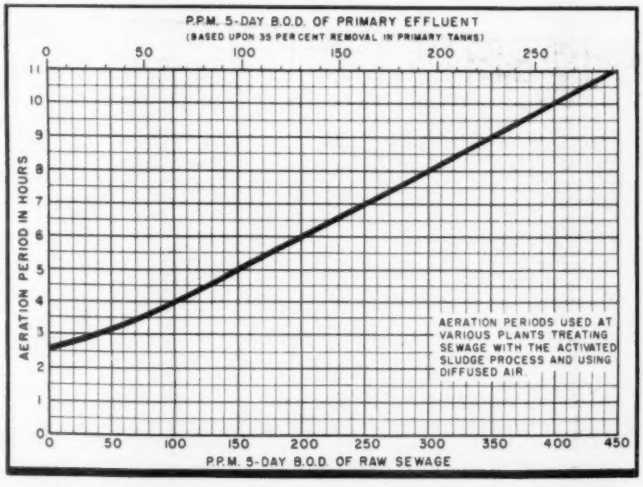
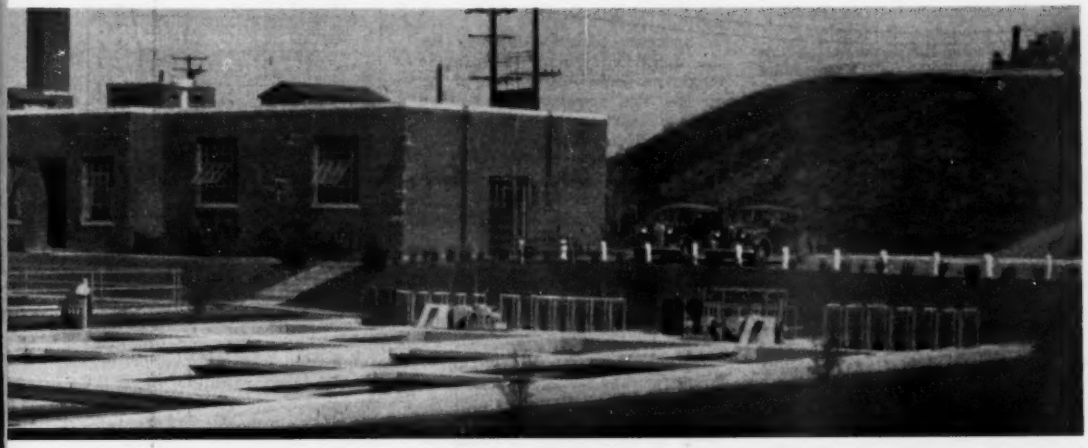
THE activated sludge process, with its high degree of treatment, low first cost and freedom from odors and flies, is admirably suited for treating sewage from defense plants and military training camps. The high degree of treatment gives assurance that the effluent may be discharged into relatively small bodies of water or even dry runs. Usually defense establishments are located on the outskirts of municipalities remote from existing municipal sewers. When this condition exists a separate sewage plant for the treatment of the wastes from the defense plant or camp is required. With activated sludge, the sewage treatment plant may be located close to the factory or even within the camp, since only a limited area is required.

In digestion of the resulting sludge, gas is generated which may be collected and used to drive gas engines. In municipal installations this is the standard practice. The gas engines are used to drive the blowers for the aeration tanks and often to operate generators to produce electric power for the motors on pumps and collectors. Larger plants usually produce enough power by this method to take care of normal requirements. In addition heat from the jacket water of the gas engines may be recovered and used to heat the digester and control buildings. The amount of gas produced by the digester is directly proportional to the strength of the sewage. Thus, the strong sewages so often found in defense establishments, can be utilized exceptionally well.

During World War II, twenty military installations and many more defense plants employed the activated sludge process in the treatment of their sewage. Experience in the operation of these plants shows that the aeration equipment must be designed in accordance with the strength of sewage involved. This correlates with long experience in the design and operation of aeration equipment for municipal activated sludge plants. Formerly it has been the practice to design activated sludge plants with the same detention period and air supply regardless of the strength of the sewage. This method of design led to



● ***FIG. 1. Aeration periods for treatment plants using diffused air.***

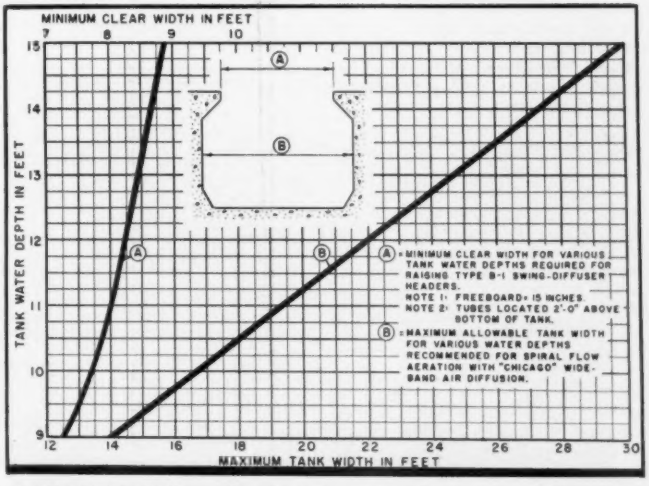


TREATMENT PLANTS

the false assumption that activated sludge plants are critical in operation and subject to upsets due to shock load. In these cases, with a fixed detention period, the plant was overloaded at the start if strong sewages were encountered. This would not have been the case if the plant had been designed with an aeration period and air supply in proportion to the general range of the sewage strength. This is true for plants treating either domestic sewage, industrial wastes or a combination of the two.

Detention Period

Proper aeration periods in the aeration tank for activated sludge plants using diffused air are shown in the chart herewith, Fig. 1. The curve is applicable to diffused air plants having a range of flow of from 1 to 2 mgd and includes a suitable factor of safety. For larger plants the aeration period may be somewhat shorter for the various sewage strengths, depending on the composition of the sewage to be treated. It is not within the scope of this article to discuss aeration systems for very large plants, or for modifications of the process. The chart shown is based on studies of the operation of activated sludge plants treating sewages of various strengths and composition and located in widely scattered points throughout the country. This curve has been applied in the design of the aeration equipment for hundreds of successfully operating plants. The chart shows that for 200 ppm BOD in the raw sewage a 6-hour aeration period should be employed; it also shows that for 300 ppm BOD an 8-hour aeration period should be employed. The curve is based upon a reduction of 35 per cent in BOD in the primary treatment phase. Experiences in World War II showed that the removal in BOD through the primary system at army camps was not as high as the 35 per cent usually given in the primary system of domestic sewage treatment plants. Many of the army camp plants showed a reduction of only 20 per cent in the primary system. This reduced efficiency of the primary system should be taken into account in designing the aeration system for army camps by using the figures at the top of the chart which give recommended detention periods for a given strength primary effluent. For example a 200 BOD sewage requires 6 hours detention period with 35 per cent reduction in BOD of the primary effluent. With



● ***FIG. 2. Tank dimensions for treatment plants using diffused air.***

only 20 per cent reduction, the BOD of the primary effluent will be 160 and using the scale at the top of the chart for 160 BOD primary effluent, a 7-hour aeration period would be required instead of the 6 hours usually required for domestic sewage.

Experience in World War II showed that the population at army camp installations fluctuates considerably. For this reason the necessary settling tank and aeration tank capacities should be divided into a number of tanks so that these tanks can be taken out of service or included in the plant operation as the flow increases or decreases. The resulting high degree of flexibility assures a continuous high-quality effluent under widely varying plant loads and with minimum cost in structures. The low night flows encountered are beneficial to the process. These low flow periods permit the plant to treat effectively peak flows without a corresponding increase in the capacity of the aeration units.

Correct tank dimensions for aeration tanks using the diffused air method of aeration are shown in the accompanying diagram, Fig. 2. Curve B gives the recommended tank width for various depths of sewage in the tank. The necessary tank volume is calculated from the detention period as shown on Fig. 1, adding 25 per cent to the design flow to allow for return sludge. Knowing the tank width, depth and volume, the total length of aeration tank necessary may be calculated. This is done by dividing the cross sectional area, as found by multiplying the width and depth, Fig. 2, into the volume of the tank. This tank length should then be provided in several tanks to give flexibility as described above. However, the minimum length should be not less than three times the tank width.

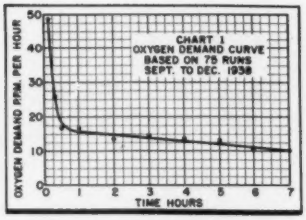
For large plants a 15-ft. water depth is recommended. This depth gives maximum economy in plant construction cost since less concrete and aeration equipment per unit of tank volume are required. However in smaller plants the use of a 15-ft. water depth usually provides more tank capacity than is required. When this is the case, a water depth should be selected that will provide at least two aeration tanks for flexibility. Obviously duplicate tanks cannot be provided in extremely small installations. When single tanks are necessary because of low flow the flexibility is provided by increased capacity of the aeration equipment.

Air Supply

The use of swing diffusers for the aeration system will provide maximum flexibility in supplying air to the sewage. Each swing diffuser has provisions for attaching a widely varying number of diffuser tubes. The correct amount of air for any given sewage may be obtained by oxygen demand tests taken on the sewage or a similar sewage. The oxygen demand test may be made by the chemical method described on page 810 of volume VII of the Sewage Works Journal or by the use of an Odeeometer.

A typical oxygen demand curve for a domestic sewage is shown in Fig. 3. The area under the curve gives a measure of the air requirements at various points in the aeration tank and the diffuser tubes should be spaced to furnish the air required. For example, a study of the curve shows that far more air is required at the head end of the tank than is required at the effluent end of the tank. The swing diffusers at the head end of the tank have a large number of tubes while those at the effluent end have only a few tubes. Experience shows that a minimum of 3 cfm of air per foot of tank length is required to maintain circulation of the tank contents. For this reason the diffuser tubes should not be spaced more than 2 ft. apart.

Air requirements for various strengths of sewage, assuming that the diffusers are spaced in accordance with the oxygen requirements of the sewage, are shown in Fig. 4. A study of the chart shows that for 35 per cent removal of BOD in the primary tank 0.8 cfm of air per gallon of sewage is required for 200



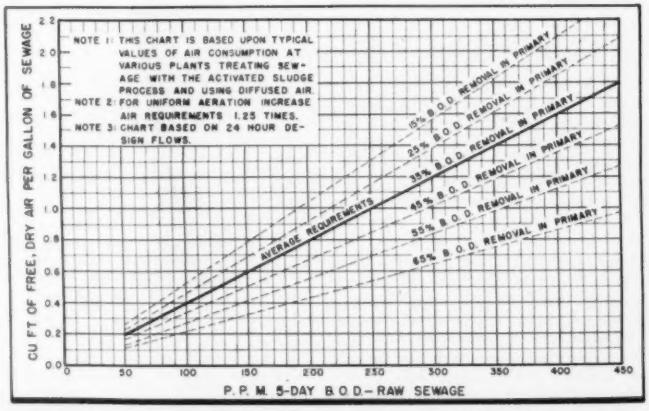
● **FIG. 3. Typical oxygen demand curve for domestic sewage.**

BOD sewage. However if the BOD removal in the primary tank is only 20 per cent, as was found in many army camps in World War II, then in accordance with the curve, 1.0 cfm of air per gallon of sewage should be provided. Sufficient air capacity should be provided by duplicate blowers so that stand-by blowers are available at all times to provide the required amount of air.

Pre-Aeration

In view of the low efficiencies given by the primary tanks in military installations during World War II, the use of pre-aeration to increase the efficiency of these units is recommended. Where pre-aeration is used, present standards call for a minimum of thirty minutes of pre-aeration at design flow. Many authorities recommend a 45-minute minimum detention period for pre-aeration at design flow. In application the pre-aeration tank is similar in appearance to a standard aeration tank. The amount of air supplied depends on the strength and character of the sewage being treated. The minimum should be 0.1 cu. ft. per gallon. Tank velocities of 2 ft. per

(*Continued on page* 118)



● **FIG. 4. Air requirements for various strengths of sewage.**

HOW TO DESIGN TRICKLING FILTERS

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THE trickling filter has proven to be one of the most versatile tools in biologic treatment of sewage and organic industrial wastes Contemporary technical literature abounds in examples of the application of such filters to the successful treatment of new types of wastes. While the low rate filter is holding its position in places where a well nitrified, stable effluent is justified, the high-rate filter continues to find wide application both in municipal and industrial waste treatment plants. Since the war the number of plants installed in this country and Canada using high-rate filters unquestionably exceeds all other types of biologic treatment plants combined.

There are several reasons for the popularity of the high-rate filter type of plant. One is its economy, not only in first cost but in operation. Another is that it is relatively simple to operate and easy for an operator to understand. Freedom from odors and filter fly nuisance is still another reason for its appeal. The needs of the armed services during the last war gave high-rate filters a big impetus and resulted in the collection of a considerable amount of operating data by which performance of new works could be predicted with reasonable assurance.

A forward step in the advancement of high-rate filters was the Tentative Standards issued in 1944 by the Upper Mississippi River Basin Sanitation Agreement, a group of several midwestern states. These standards furnished engineers with a uniform basis for design of high rate filter plants which would be acceptable to the authorities. Plants designed according to these standards, when properly constructed and operated, have shown a performance unusually close to predictions.

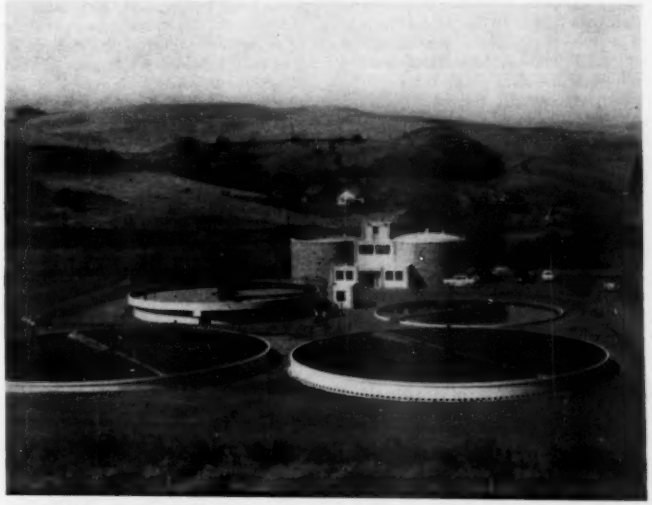
1951 Tentative Standards

Recently, a group of public health engineers representing ten states, including five of the original group, has issued a greatly enlarged series of Tentative Standards which have been expanded from the original to cover the entire range of sewerage and sewage treatment practice. This represents a tremendous accomplishment which should go a long way towards unifying practice not only in these ten states but over the rest of the country as well. The standards deal essentially with municipal practice and the treatment of municipal sewage with adequate leeway left to the consulting engineer to exercise his skill and knowledge in the solution of special problems.

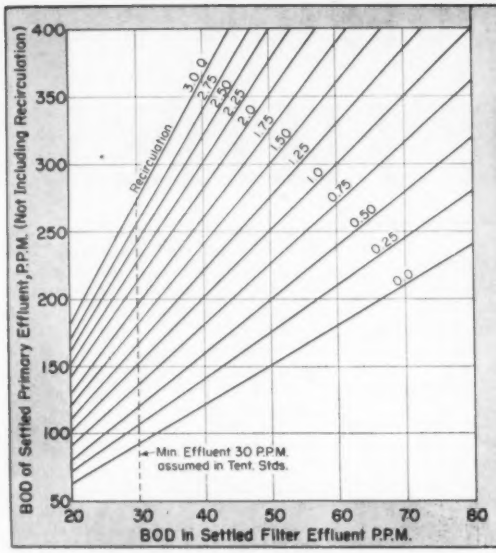
The section dealing with high rate filters is largely a remodelling of the 1944 Standards with a modification of the method of determining performance. The 1944 Standards for high rate filters with recirculation, which were designed to produce a settled effluent of 30 ppm BOD, required that the filter load, recirculation included, should not exceed 0.75 lb. of BOD per sq. ft. of filter area. Filters were to have a minimum depth of 6.0 ft. Thus, permissible loading was 120 lbs./1000 cu. ft. or 5220 lbs. per acre foot. Conservative practice usually limited the design loading to about 50 percent of the maximum allowable.

The 1951 Tentative Standards have abandoned the loading per unit of area in favor of loading per unit of volume. Thus, for single stage units maximum loading, including recirculation, shall not exceed 110 lb. per 1000 cu. ft. of filter volume or 4800 lb. per AF. Filter depths are not mentioned.

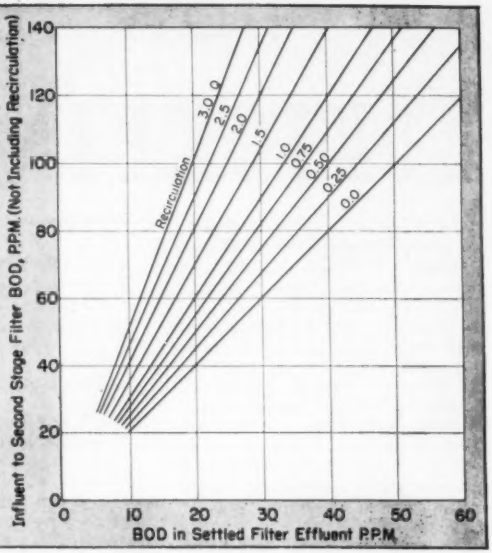
Tabular data appended to the 1944 Standards showed expected effluents from single stage filters for various strengths of settled sewage with various recirculation ratios. The remarkable feature which this data showed was that, as the dosing rate was increased, a gradual improvement in the effluent was obtained. This came about through the use of the Walton formula and such an improvement was actually observed in military camp operating data. The



● *TWO stage biofiltration plant at Pullman, Wash., serves 15,000.*



● *FIG. 1. Performance diagram to estimate probable performance of trickling filter.*



● *FIG. 3. Expected performance of second stage filters of two stage filter plant.*

1951 Standards have omitted the tabular data of the earlier standards but it is possible to use the statements in the text to construct new tables or diagrams to estimate performance and avoid repeated computations.

Performance Diagrams

Fig. 1 is such a diagram. It shows expected performance based on the 1951 Standards of either single stage high rate filters or the primary stage of a two-stage plant providing, of course, intermediate settling is used following the first stage filter.

In determining the recirculation ratio, R, it does not matter whether recirculation is as shown in Fig. 2a or as in Fig. 2b or as in Fig. 2c. In Fig. 2c, however, R is the sum of R_1 and R_2. So far as effluent is concerned any one of the three should yield the same final effluent but each flowsheet has advantages for specific conditions. When the recirculation includes underflow from the final clarifier, and this is returned to the primary clarifier, it eliminates the need for a separate means of handling the humus sludge. Flowsheet 2c has this feature and, in addition, by proper proportioning of R_1 and R_2 it is possible to make the final tank identical in size with the primary. Incidentally, the final clarifier need not be sized to handle R_1 as this volume does not overflow the weirs of this unit.

When R_1 is returned to the primary clarifier the removal of BOD in the raw sewage should be estimated independently of the effect of R_1, using the curves shown in Tentative Standards for removal of BOD by primary sedimentation. The area of the primary clarifier, however, is to be determined from the ratings in the Standards on the basis of the total feed to the unit, including recirculation. In many plants, return of a portion or all of the recirculation to the primary has proven very effective in control of odors in the raw sewage and in reducing scum.

Roughing filters with higher loadings are also included in the Standards with practically no change except the loading is to be computed on a volumetric instead of an area basis.

Two Stage Filters

The section on standards for the second stage of two stage high rate filters is a welcome and useful addition. Two stage high rate filters will be considered as a means of reducing the BOD below 30 ppm, the assumed limit of single stage filters. The expected performance of the second stage of two stage plants, according to the Standards, is two-thirds of that expected in the first stage. This presumably takes into account reduced "treatability" of the BOD remaining after passage through the primary stage. Expected performance of such units is shown in Fig. 3. Flowsheet 2b is frequently used in the second stage with the units shown becoming respectively the intermediate clarifier, the second stage filter and the final clarifier.

The usual accepted filter loadings of 2400 to 3000 lbs. of BOD in the settled primary sewage to one acre foot of stone will almost invariably result in a filter loading lower than the permissible loading, including recirculation, of 4800 lb. per acre ft. or 110 lb./1000 cu. ft. allowed in the Standards. However, as a check on higher loadings, the minimum volume may be determined by the following for single stage filters:

$V = (PE + R \times FE) \times MGD \div 13.2$

Where:

V = minimum volume in thousands of cu. ft.;

PE = Settled primary sewage BOD in ppm;

FE = Final effluent BOD in ppm (Estimated from Fig. 1);

R = Recirculation ratio; and

MGD = Raw sewage flow in million gallons per 24 hr.

or $V = (PE + R \times FE) \times MGD \div 576$

Where:

V = minimum volume in acre feet, and other values are same as above.

If the settled primary BOD and final effluent BOD are expressed in lb/24 hr., then:

Vaf = (P + RE) ÷ 4800 and
Vmf + (P + RE) ÷ 110
Where:
Vaf = Volume in acre feet;
Vmf = Volume in 1000 cu. ft.; and
P and E are **total** lb/24 hr of settled primary and final effluent BOD respectively.

Dosing rate on filters according to the standards should be in excess of 10 mgad and up to 30 mgad, recirculation included.

Adequate underdrainage to permit air currents to circulate as well as to accommodate maximum liquid flows are again required and this is a very essential requirement for successful performance of any high rate filter.

Illustrative examples of the application of the new Tentative Standards for high rate filters seem unnecessary as the procedure is the same as in the original Standards. These were thoroughly discussed in the Handbook on Trickling Filters published in 1947 by PUBLIC WORKS and are doubtless familiar to most engineers. Occasionally, however, it is not apparent how some problems may fit into the pattern of these Standards. An illustration should be of interest.

Illustrative Example

A city has a treatment plant with badly overloaded low rate filters which it wishes to retain and utilize as fully as possible. It has decided to add treatment facilities ahead of these filters which will reduce the load upon them sufficiently so that a completely stabilized final effluent of not more than 20 ppm BOD can be obtained. Data from the existing plant are assumed as follows:

Location—Northern part of country;
Design flow—6.0 mgd;
Settled Primary Clarifier effluent —220 ppm BOD (11,000 lb/day);
Existing low rate filters—4 units 100 ft. dia. by 7 ft. rock depth;
Area—0.72 Ac.;
Volume—5.04 Ac. ft.; and
Desired final effluent — 20 ppm BOD.

In the solution of this problem it is probably simpler to determine the loading which the low rate filters can safely handle and then select a primary stage of high rate filters to yield an equal effluent.

For a stable plant effluent and with due consideration to climatic conditions, a loading on the low rate filters not to exceed 400 lb. per AF seems desirable. Applying this loading to the volume of stone in the existing low rate filter, a total loading of 2016 lb. BOD may be applied, equivalent to 40 Ppm.

With a primary clarifier effluent of 220 ppm, the problem is to insert a high rate filter between the primary clarifier and low rate filters which will produce an effluent of 40 ppm. Reference to Fig. 1 shows that this can be accomplished according to the Standards by using a recirculation ratio (R) of 1.25. The **minimum** volume of filter stone to meet the Standards as determined by the above formula is:

V = (220 + 1.25 x 40) x 6.0 ÷ 13.2 = 123,000 cu. ft.
or V = 2.8 AF.

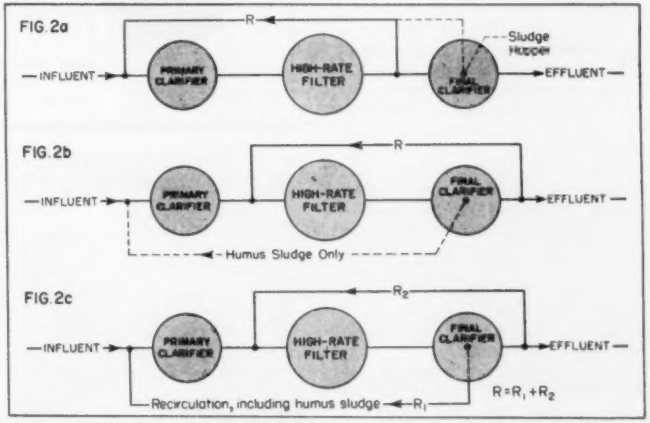
Two filters 140 ft. dia. by 4-ft. depth will give the necessary volume.

Assuming flowsheet shown in Fig. 2b. is used so as not to overload existing sedimentation tanks, then the new clarifier following the filters should be able to handle 6 mgd sewage flow plus 1.25 times 6.0 or 7.5 mgd recirculation, or a total of 13.5 mgd. Using the recommended rating of 1000 gal./sq. ft./day, an area of 13,500 sq. ft. is required for the new intermediate clarifier. This can be obtained in a unit approximately 130 ft. in dia. or equivalent.

Thus, by inserting between the existing primary clarifiers and low rate filters, two high rate filters each 140 ft. by 4 ft. and a clarifier 130 ft. dia. the plant should be able to turn out a very satisfactory effluent. Present facilities are being fully utilized and the use of maximum loadings in the proposed intermediate stage seem fully justified.

An alternative might be to use a smaller roughing filter with a higher loading but there would be a question as to whether the greater load in the effluent of such a roughing filter could be safely applied to the low rate filters and still yield the required plant effluent.

This method of relieving existing overloaded low rate or standard filters is being applied to many plants which appear to have outlived their usefulness. By using the data on high rate filters contained in the Tentative Standards many such plants can be rejuvenated at considerable saving over the cost of a new plant. Using the Standards for the design of new plants should relieve engineers of any hesitancy in the selection of design factors. So far as this writer is concerned, the Tentative Standards section on high rate filters seems very useful and is consistent with performance of operating plants. Many debatable details of former years are settled by the simple straightforward statements in the new Standards.



● ***FIG. 2. Three methods of recirculation used in single stage plants, or as the second stage of two stage high rate filters.***

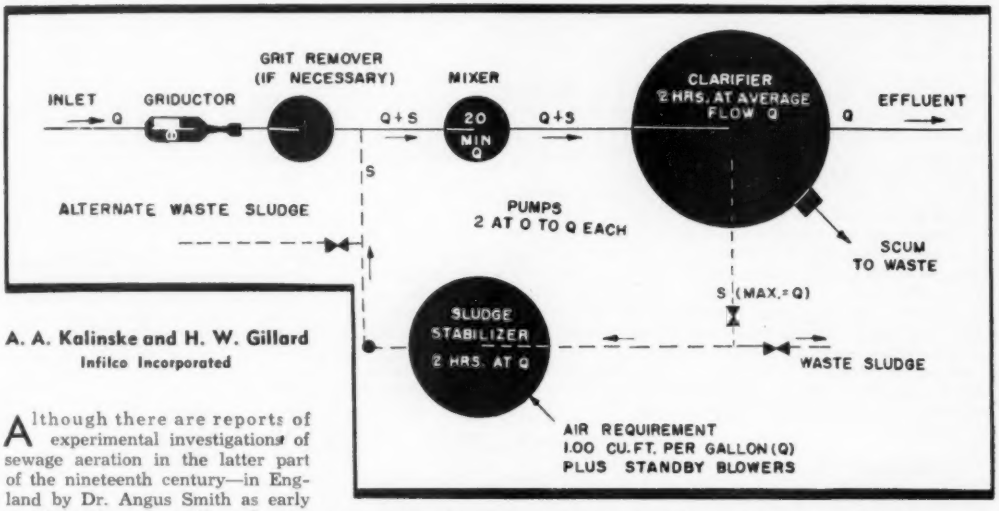
References

"Joint Statement of Policy" Sewage Works Journal Sept. 1944 Page 909

Graham Walton "High Daily Rate Filter Performance"—Publication of the Upper Mississippi River Sanitation Agreement — March 1943

Handbook of Trickling Filter Design —1947 Revised Edition — Public Works Magazine

ACTIVATED SLUDGE for SEWAGE



● ***SUGGESTED flow diagram for Biosorption Process, based on average flow of normal strength sewage. Further data are given in text.***

A. A. Kalinske and H. W. Gillard
Infilco Incorporated

Although there are reports of experimental investigations of sewage aeration in the latter part of the nineteenth century—in England by Dr. Angus Smith as early as 1882 (1), and in Massachusetts by the Lawrence Experiment Station—the first recorded use of the process was by Ardern and Lockett at Manchester, England, in 1913, according to Mohlman (2). In the intervening years, research (3) and development have contributed to a better knowledge of the important factors in this method of sewage and waste treatment.

The advantages and benefits of the activated sludge process may be listed in the following order of their importance: (a) Low cost of construction; (b) high degree of treatment, based on reduction in BOD and SS, with production of a well-nitrified effluent; (c) undigested waste sludge of high fertilizer value; (d) freedom from fly and odor nuisances in operation; and (e) ability to use the effluent for many non-potable purposes, as irrigation and industrial uses (4). Compared with other types of complete treatment, the saving in initial cost has justified the greater plant operation costs. Considered on the basis of cost per pound of BOD removed, the activated sludge process will prove the more economical.

Some of the early larger activated sludge plant designs were based on results obtained from pilot plant investigations, but more often such plants were designed on the results of previous experience from plants in operation. Aeration periods ranged from 3 to 8 hours (5) with 20% to 30% sludge return and 1 to 2 cu. ft. of air per gallon of sewage. Later, due to requirements of State Sanitary Engineers, these design criteria became more or less standardized to 6 hours aeration, based on sewage flow rates plus sludge return, and 1 to 2 cu. ft. of air per gallon, with standby blowers provided. For mechanical aeration plants, retentions of 8 hours, on the same basis, were required. It was found that digestion tank capacities of 5 cfc were required, as compared with about 3 cfc for sludge from biological filter plants.

To avoid "rule of thumb" criteria, other design bases (6) were proposed and used, such as: Pounds of BOD per unit of aeration tank volume, usually 25 to 30 lbs. per 1,000 cu. ft.; pounds of BOD per 1,000 cu. ft. of air; etc. These design criteria are about the same as those previously given if a BOD contribution of 0.17 lb. per capita, a sewage flow of 100 gpcd and 35% removal in the primary tanks are assumed. However, they furnish a rational means of providing for higher strength sewages or wastes in plant design.

Plant Design Details

More recent (Jan., 1951) tentative activated sludge design bases have been proposed by a committee composed of a representative from each of the following state health depa:tments: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania and Wisconsin. This report reflects the thinking of engineers primarily interested in the public health aspects of sewage treatment. The following data are abstracted from these "tentative standards": The capacity of the aeration tank shall be the larger volume established by the following criteria: (a) For design flows (exclusive of returned sludge) from 0.2 to 0.8 mgd, the detention time shall be 7.5 hours; in excess of 0.8 mgd, detention time shall vary from 7.5 hours at 0.8 mgd to 6 hours at 1.0 mgd, decreasing in propor-

and WASTE TREATMENT

tion to the increase in flow within these limits. (b) A tank volume of 30 cu. ft. per pound of 5-day BOD in the aerator influent is required (exclusive of return sludge).

Tank volumes for mechanical aeration are generally set at 50% greater than those determined for diffused air aeration in (a) and (b) above. Tank depth must be not less than 10 ft. nor more than 15 ft. The air supply must be sufficient to maintain 2 ppm dissolved oxygen in the aeration tank. The air diffusion system, including piping, blowers and auxiliaries, must be capable of supplying to the aeration tank 1,000 cfm of air per pound of applied BOD and both blowers and air diffusion equipment must be capable of supplying 150% of normal requirements. Removal of diffuser media for inspection, cleaning and replacement, as well as air control valves, are required.

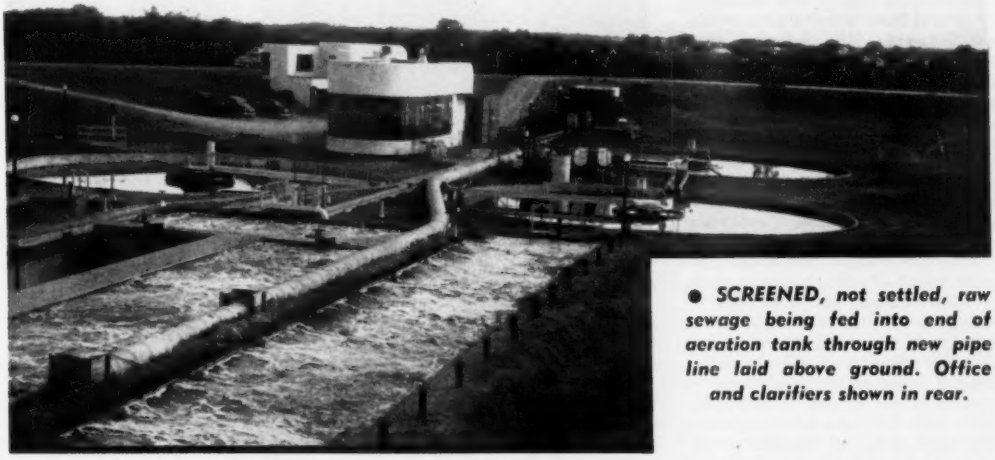
The primary reason for such rigid standards is, of course, to assure activated sludge installations that will give desired treatment results. This is a laudable desire. One may well wonder, however, whether actual adoption of such "standards" will not act as a deterrent to advance in this field, many of the most valuable contributions to which have been due to forward thinking engineers unsatisfied with existing standards.

Although the low initial cost of an activated sludge type plant would seem to make the process most attractive to those industries requiring treatment of their wastes, there are few references to such use in the literature. There are many references to use of the process for treatment of industrial wastes combined with domestic sewage, such as at Sioux Falls, S. D. Mallory successfully treated milk wastes at Zeeland, Mich. (7) and West Chester, Pa. (8). Describing operation of a plant at the Dean Milk Company at Huntley, Ill., Hasfurther & Klassen (9) report encouraging results in the treatment of milk wastes using 1000 cubic feet of air per pound of BOD with a recirculation ratio of 1 waste to 5 return.

It is possible that the great variations in quantity and in organic content of most industrial wastes have been a factor in the apparent lack of interest in activated sludge for the solution of these problems or it may have been a lack of interest in waste treatment installation by industry prior to the past decade.

Recent Developments

During the last decade there have been developments which have made the activated sludge process more economical and efficient. In a conventional activated sludge plant, having rectangular aeration basins, the raw sewage or settled sewage and the return sludge are introduced together at the entrance end of the basins and the mixture flows through these with a retention time of 4 to 8 hours. Gould (14) and McKee and Fair (15) were instrumental in altering this arrangement to distribute the incoming sewage along the aeration basin. This change was based on the fact that the major portion of the oxidation occurs at the influent end of the aeration basin, oxidation then gradually tapering off. In other words, the influent half of a basin does much more of the oxidation work than the last half. In order to utilize more fully this oxidation capacity "Step Aeration", "Distributed Loading" or "Multiple Point Dosing" was developed. In such a system the sewage can be introduced in regulated amounts at multiple points in the tank. This principle has been used in the design of the Tallman's



● ***SCREENED, not settled, raw sewage being fed into end of aeration tank through new pipe line laid above ground. Office and clarifiers shown in rear.***

Island Plant in New York City. Also, New York's Bowery Bay Plant has incorporated step aeration; and, in recent years, the Wards Island Plant had its capacity considerably increased by step aeration. It has been possible to obtain a good effluent with as low as 2½ hours detention in aeration tanks by the use of the step aeration method. This increase in the capacity of the aeration tank is due to the fact that oxygen utilization is much more uniform throughout the length of the aerator.

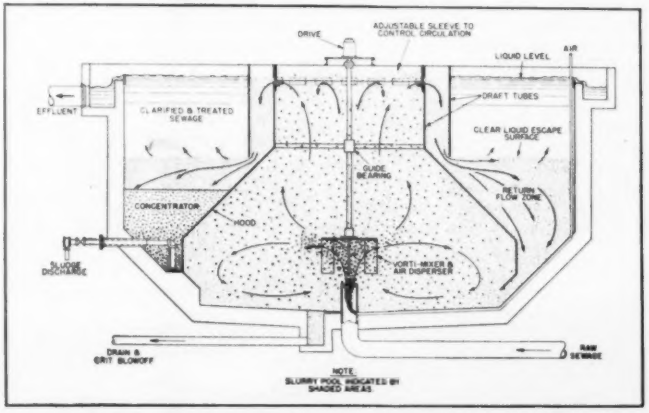
In the early days of sewage treatment one criterion for the efficiency of treatment plants was the degree of nitrification obtained. The activated sludge process is capable of producing high nitrification. In England, where this process was developed, such high nitrification is quite important because of the large concentrations of population on relatively small streams. This is also true in the northeastern part of our country. However, it is now recognized that very large benefits are obtained from the removal of the solids in sewage, even with only first stage, or so-called carbonaceous matter, oxidation. Also, plant studies have shown that very short periods of aeration of the settled sewage in contact with returned sludge can produce from 65% to 80% reduction of SS and BOD. For instance, Setter and Edwards (16) indicated that with 1½ hours aeration they were able to reduce the SS and BOD about 70%, while a 3-hour aeration period resulted in a reduction of about 80%. These reductions refer to the settled sewage introduced into the aeration tanks. Setter and Edwards used the term "modified sewage aeration" rather than "high rate activated sludge treatment."

With this method, the amount of solids returned is much smaller than in conventional activated sludge plants, amounting to only 600 to 800 ppm in the mixed liquor. At the Jamaica (New York City) plant, using 2 hours aeration and a solids content in the aerator of 650 ppm, BOD and SS reductions of over 80% were obtained. The amount of air used was 350 cu. ft. per pound of BOD removed. Apparently, an activated sludge plant can be designed to produce any quality of effluent desired between that of plain settling and true activated sludge treatment. The poorer the effluent quality that is acceptable, the shorter the aeration period can be and also the less air need be used. In general, an effluent having a BOD of 30 to 50 ppm can be obtained, and the sludge that is produced for final disposal will have twice the density of ordinary activated sludge. Also, though the modified or high rate activated sludge can be upset by unusual loads of strong sewage or industrial waste just as the ordinary activated sludge plant is, its recovery will occur in a matter of hours instead of days.

High Rate Treating Unit

Utilizing the fact that oxygen utilization by activated sludge proceeds at a very high rate if proper conditions of food supply and oxygen are maintained, there has recently been developed by Infilco a high rate treating unit called the Aero-Accelator. This treating unit, together with its theory of operation, has been described by Kalinske (17) and Eidsness (18). Extensive pilot plant results at various locations throughout the country are given by the above authors.

The Aero-Accelator is a single unit for obtaining mixing, aeration, and clarification, together with oxidation by use of activated sludge which is constantly kept in circulation. At no time is any of the sludge allowed to settle except in a small hopper from which the waste sludge is drawn off. Sewage and air enter the unit through the bottom immediately underneath a disperser which mixes the incoming sewage with a large volume of activated sludge and simultaneously disperses the incoming air throughout the entire mass of the sludge. Circulation is maintained by the air lift. Pilot plant studies with this unit on a relatively weak sewage at Elmhurst, Ill., indicated that, for a total retention time on the order of 2 hours and an air supply of about ½ cubic foot for each gallon of sewage treated, an effluent having a BOD and SS content of 20 to 25 ppm could be readily obtained. Similar studies at Austin, Texas, on a sewage having a BOD of about 200 ppm, indicated that a similar effluent BOD and SS could be obtained with an air supply of ⅔ to ¾ cubic foot per gallon. At Sioux Falls, S. D., where the raw sewage had a BOD and SS of 200 to 300 ppm, an effluent was obtained with a BOD and SS of 30 to 35 ppm with a retention time of 2 to 2½ hours and an air supply of about ¾ cubic foot per gallon. Such treatment in a single unit having a total retention time for both aeration and clarification of the order of 2 to 3 hours is certainly remarkable. It is hoped that full-scale plant results will be available in the near future.

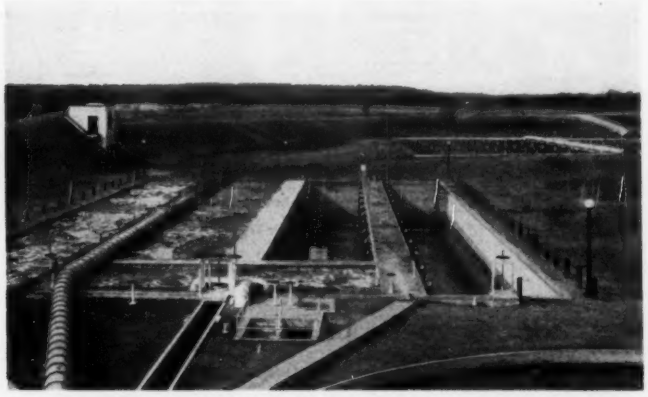


● ***AERO-Accelator for high rate activated sludge treatment.***

Basic Research

During the last two years basic research work has been carried on by Ullrich and Smith of Austin, Texas, and by Hood and Eckenfelder of Ridgewood, N. J., resulting in utilization of the activated sludge process in a somewhat different manner than has been done to date. This process is being referred to as the "Biosorption Process." A flow diagram showing how it works and the equipment utilized for carrying out this process is shown on page 78. In this process, which is a modification of the standard activated sludge treatment process, advantage is taken of the absorption and clarification power of good activated

sludge. Screened or settled sewage enters a small mixing tank together with the returned sludge; this tank has a retention time of about 20 minutes and air is supplied to this tank. Following this, the sewage and activated sludge mixture flows to a clarifier where a clear effluent is produced. The sludge is returned to a so-called sludge stabilizer having a retention time of about 2 hours. In this sludge stabilizer, the solids are aerated so that the absorbed organic matter is oxidized. Only carbonaceous oxidation occurs in this process because of the short retention time. The sludge from the stabilizer is fed into the incoming raw sewage for further absorption and clarification. Excess sludge is wasted from the stabilizer and is handled from there by any of the conventional methods.



● ***WITH biosorption, half of Austin plant handles flow.***

The Austin Plant

This process can be adapted to existing conventional activated sludge plants very simply. In fact, in recent months, Ullrich of Austin, Texas, has done just that with his conventional activated sludge plant. The raw screened sewage, without passing through the primary, is piped to a point near the end of the aeration basin system. The returned sludge from the clarifiers enters the influent of the aeration basins. The last portions of the aeration basins are thus used as the mixing step for the raw sewage and the stabilized sludge, whence the mixture of sewage and sludge flows to the clarifiers. Operating data in treating about 7 mgd average flow are available for about three months. The incoming sewage BOD has varied from 200 to 250 ppm and the treated effluent BOD has ranged from 10 to 15 ppm. Suspended solids in raw and effluent were similar to the BOD values.

The Austin plant was altered so that one-half of the aeration basins are now being utilized. The above data were obtained under conditions where the mixing time was of the order of about 30 minutes; the time in the aerator or sludge stabilizer was 2 to 3 hours; and the time in the final clarifier about 2½ hours, all based on the average flow of sewage. The amount of air used has varied from ¾ to 1 cf/gal of sewage treated. The returned sludge, based on average sewage flow, was 35 to 40%. It is believed, on the basis of pilot plant experiments, that similar results could be obtained if a higher percentage of the sludge were returned even though the time in the aeration or stabilizer basin were reduced to less than 2 hours. It is thus quite apparent that the Biosorption Process will give results which are comparable to conventional activated sludge treatment in considerably smaller structures.

Operational Controls

One of the principal criticisms of the activated sludge process has been the fact that the process does require a considerable degree of control, but quantitative measures to permit such control have been difficult to obtain. For instance, proper operation of the activated sludge process depends on maintaining the sludge in proper condition. However, an operator does not know what is happening to the sludge until it actually has happened and he visually observes its poor quality or obtains a very high index. Even to measure the index he has to make a suspended solids determination which is time consuming. After the sludge has gone bad, and he sees that it is bad, it is too late to apply proper corrective measures. Also, though he does apply these corrective measures it will be at least several hours, and maybe days, before he can get the sludge back into good condition. Therefore, there has been a great need for some measurement that could be made instantaneously which would tell an operator the condition of the sludge in his aeration basin at any time.

Measurements of the dissolved oxygen in the mixed liquor at several points in the aeration tanks should be made to maintain proper control of the process. This is probably one of the most important quantitative measurements. However, dissolved oxygen will not tell the whole story so far as the condition of the sludge is concerned at any given time. Also, it will not tell the operator whether the conditions are such that the sludge is, or is not, on a down-grade so far as its quality is concerned.

Hood (19) has indicated how the oxidation-reduction potential can be used as a quantitative measure for the control of sewage treatment processes in general, and particularly that of activated sludge. The so-called OR potential is defined as the electrical pressure existing in a liquid as a result of the respective concentrations of oxidants and reductants that are present. In a complex mixture of sewage there are many oxidation and reduction processes going on. The OR potential measurement indicates whether the oxidizing or reducing processes predominate. The potential electromotive force is measured by means of a vacuum tube potentiometer equipped with an appropriate electrode system. Hood and Rohlich (20) have described in detail how such OR potential measurements can be made in sewage plants. Rohlich (21) has stated that the complexity of the oxidation process and the heterogeneous character of activated sludge and sewage do not allow for any simple explanation of the process, but the measurement of OR potential changes may prove of value in the interpretation of conditions that will lead to better control.

The latter phrase is of consider-

(*Continued on page* 120)

SELECTING AND INSTALLING PUMPS FOR SEWAGE AND SLUDGE

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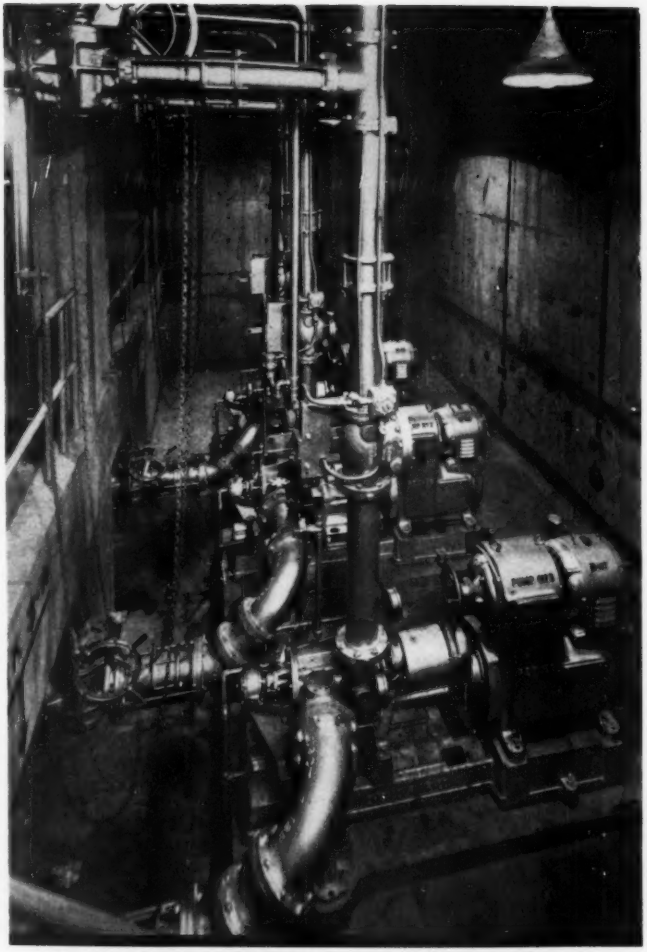
THE selection of pumps and the design of a wet well for a raw sewage pumping station are based upon the following considerations: (1) The present 24-hour average rate of flow; (2) The 24-hour design flow of the station; and (3) The peak rate of flow.

The present 24-hour average rate of flow should, wherever possible, be obtained by actual field measurements. The 24-hour design flow can then be chosen for the anticipated increase in population expected during the life of the pumping station. Where rather rapid population growth is anticipated, it is often desirable to build concrete structures sufficiently large to take care of flows ten to twenty years in the future, but to select pumps to handle only the present flow and to provide space for installing additional pumps as the flow increases.

Flush-Kleen type installations, without screens or comminutors, may be used in unattended stations with maximum flows up to 950 gpm and for lifting sewage from deep basements of large buildings. For flows exceeding 950 gpm, and for all installations at sewage treatment plants, a comminutor should be installed ahead of the pumping units, permitting the use of non-clog pumps.

For military installations the expected 24-hour flows are given in the Engineering Manual, Chapter VII, Section II, January 1951 as follows: Hospitals (including station hospitals), 100 gallons per



● ***THREE of 12 primary sludge pumps at the Hyperion plant.***

capita; all other types of posts, camps, depots and plants, 70 gallons per capita; and 30 gallons per 8-hour shift per nonresident or worker in an industrial area (90 gallons per day rate).

The Manual also lists the peak flows to be expected from the contributing population, as shown in Table I.

TABLE 1.—Peak Flows

Tributary Population	Peak Flow to Average Flow
1,000	3.80
5,000	3.55
10,000	3.33
15,000	3.15
20,000	3.00
30,000	2.80
40,000	2.65
50,000	2.55

The size and shape of the wet well are important. If the bottom is too flat or it is too large, solids will collect in the bottom and the sewage in it may become septic. This condition may cause objectionable odors, increase soluble BOD or upset the treatment plant process.

The wet well should be as small as possible to prevent the sewage from becoming septic, yet large enough to satisfy operating and space requirements of the pumps. The dry well should be of sufficient size to permit easy access to the pumps for servicing.

Pump Selection

Generally the number of pumps required for a given station using non-clog pumps is based on the following criteria:

1. For flows up to 0.2 mgd, duplicate pumps are recommended each having a discharge rate of 175% of the design flow.

2. For pumping stations having a design flow of 0.2 to 4.0 mgd three pumps are recommended: One pump to discharge 50% to 70% of the average 24-hour flow; one to discharge 100% of the average 24-hour flow; and one to discharge 220% of the 24-hour flow or 120% of the peak flow whichever is larger.

3. For larger pumping stations four or more pumps are commonly used.

For example, a raw sewage lift station for a 1 mgd sewage treatment plant should be equipped with three pumps, which, it is assumed, will require a wet well with a surface area 15 ft x 8 ft., with a depth 5 feet below the influent invert. It is then necessary to check the requirements of the several pumps for satisfactory operation. Those requirements are as follows:

Pump No. 1 should be chosen to "ride on" the present flow, and should have an operating period of 4 to 6 minutes when operating on a differential of 2 feet in the selected size of wet well. (In determining the operating period, it may be assumed there is zero inflow).

Pump No. 2 should have an operating period of 4 to 5 minutes when operating on a 2-ft. differential and assuming an inflow of the capacity of Pump No. 1.

Pump No. 3 should be of such size that the discharge will be at least 220% of the design flow or 120% of the peak flow, whichever may be the larger.

For lift stations which discharge into small sewage treatment plants with a design flow up to about 0.2 mgd, where the cost of three pumps is not warranted, a satisfactory installation can be made using two pumps. The pumps should then be selected with discharge characteristics so that the pump can, so far as possible, "ride the flow". By this it is meant that when the inflow is small and the sewage level is near the bottom of the wet well, the discharge of the pumps will be decreased somewhat due to the pumping against a higher static head. As the flow into the wet well increases, the liquid level raises, decreasing the static head, and consequently the pump will discharge a greater capacity. In order to make this possible, the pumps selected must have as flat a discharge curve as possible so that the capacity of the pumps will substantially increase with a relatively small decrease in head. Also, the piping should be arranged so that the friction will not greatly increase as the discharge of the pump increases. The pumps should be chosen so that each pump will discharge approximately 175% of the design flow when pumping from the high water level of the wet well. Selecting the pumps in this manner will keep surging of the plant to a minimum and at the same time each pump can handle the expected peak inflow into the wet well. The pumps should be operated alternately to equalize wear. Mechanical alternators have proved very satisfactory for this service.

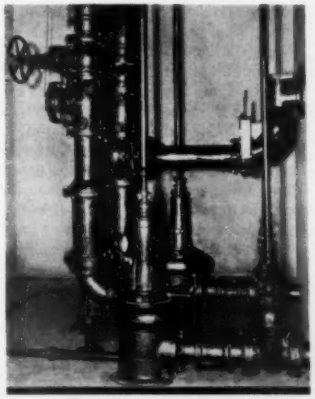
An outlying lift station which handles only a small percentage of the total flow to a sewage treatment plant can also be equipped with only two pumps, each capable of handling approximately 220% of the inflow to the station. This will not cause surging of the sewage treatment plant, as that greater portion of the total flow which flows to the plant by gravity will level out these surges. This selection of pumps is also satisfactory when the total flow to the plant comes from several small outlying lift stations. The only time surging would occur would be when several of the pumps happened to pump simultaneously.

The Flush-Kleen Sewage Ejector is well adapted for the handling of raw sewage at lift stations that do not immediately discharge into sewage treatment plants.

Pumps and Pump Drives

In defense installations it is frequently of great importance to have assurance of continuous operation of the sewage pumps. As these are usually located in outlying areas, electric power failures are not infrequent. Because of this, it is advisable to provide gas engine standby equipment to be started either manually or automatically in the event of power failure. These standby engines are usually connected to the pump through a right angle drive.

In wet wells where the operation of the pumps is to be continuous, or nearly so, closed shaft pumps are not recommended, particularly where grit and sand occurs in the sewage. The grit works into the bearings of the pump and causes them to wear. Also, the difficulty and inconvenience of inspecting and repairing these pumps makes their use unsatisfactory. Whenever any service is needed, it is necessary to remove the motor and pumps from



● *INSTALLATION of Flush-Kleen sewage ejectors at a World War II sewage plant in Texas.*

the wet well which, in most instances, is a difficult and laborious task.

In summary, the following features should be incorporated into a properly constructed pumping installation: The wet well should be properly sized and the floor should have an adequate slope toward the pump suction. There should be no suction lift and the influent sewer should always be above the high water level in the wet well.

There should be no air or gas traps in the piping system. The use of 90° header connections should be avoided; 45° laterals are preferred due to the lower friction. The discharge header should be offset from the pump discharge center line. The use of costly special fittings should be avoided; there are usually standard fittings which may be used. The discharge lines of pumps should be smaller than the common header. Check valves preferably should be placed in horizontal positions.

Separate entrances should be provided for the wet and dry wells, and a sump and sump pump should be located in the dry well unless a free discharge is available. A manhole or hatch should be provided for lowering (or raising) pumps, piping, etc.; both dry and wet wells should be adequately ventilated.

Seal water for the pumping units should not be cross-connected to the public water supply. All outside piping and outside float controls should be protected against freezing.

The Centrifugal Sludge Pump

Centrifugal pumps for handling sludge should not be used if large amounts of gas or air are present. When such gas and air are present, centrifugal pumps become air bound. For the same reason the centrifugal non-clog pump should not be used where there is a suction lift or where air or gas pockets can exist in suction lines. Water seals must be provided to prevent air from being sucked in through the stuffing boxes and to prevent grit from reaching the pump bearings. If it becomes necessary to operate a centrifugal sludge pump on a suction lift then a priming chamber must be provided. When a priming chamber is necessary then the discharge nozzle of a horizontal centrifugal pump should be on the top side of the volute either parallel to the floor or in a vertical upright position. If the discharge nozzle faces downward or is placed on the bottom of the volute parallel to the floor the pump can not be readily primed as there is no way of removing entrapped air in the top of the casing. Centrifugal pumps frequently clog when used to pump primary sludge. The whirling motion induced on the suction side of this type pump causes the sludge in the suction line to rotate in a spiral motion for a considerable distance back in the line. This whirling action will often twist and enmesh rags and stringy material in the sludge. This material tends to wrap around the impeller and clog the pump. Centrifugal pumps perform best under positive suction head conditions where a thin watery sludge relatively free from debris is being pumped.

● ***TYPICAL arrangement for gas stand-by engine installation.***

The Plunger Pump for Sludge

The plunger pump, because it is a positive displacement pump, will handle mixtures of sludge, sewage gas and air equally as well as liquids. Beyond this and its self-priming feature, it is questionable whether the plunger pump is superior to any other well designed sludge pump. The plunger pump is often noisy due to reversal stresses caused by the starting and stopping of the column of heavy fluid on the suction and discharge side at each stroke. This noise can sometimes be minimized by providing adequate air chambers. The pump requires considerable maintenance to keep the packing tight. If the packing is too soft, too loose or improperly placed the sludge will spray out around the cylinder wall causing unsightly conditions in the plant. If the packing is too tight there is danger of scored pistons or cylinders or broken shear pins. The amount of grit in the sludge determines the life of the packing as well as the wear on the pistons and cylinders.

The valves on the suction and discharge side whether they be ball or flap type require frequent attention. Stringy material will accumulate under the valve seats and around the valves and may cause the pump to stop delivering completely.

Scru-Peller Sludge Pumps

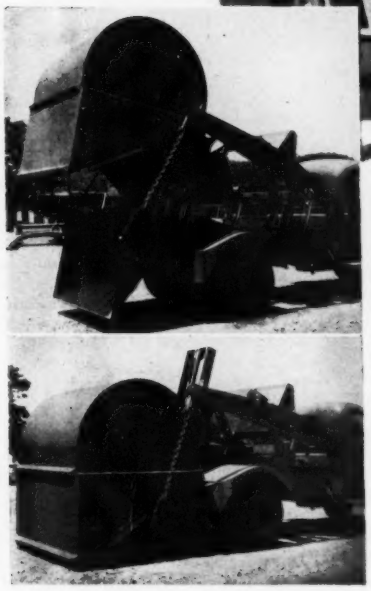
The Scru-Peller sludge pump is a modification of the centrifugal pump and operates on the force feed principal. Like other centrifugal pumps, a priming chamber must be provided if the pump is operated on a suction lift. Many of these pumps are operating successfully under suction lifts up to 15 ft. This type has the advantages of the centrifugal pump, plus the ability to pass solids without clogging. Although the pump was designed for handling primary sludge it has been used successfully at army posts since 1934 for pumping raw unscreened sewage. The Scru-Peller pump has a two-screw conveyor to give positive feed to a two port impeller. This eliminates the danger of partial sludge dewatering at the suction eye of the impeller. Shear bars are provided in the conveyor housing to cut rags and other material into sizes that will readily pass through the pump. Shear bars are also provided on the back of the impeller to prevent packing at this point. The suction opening is at right angles to the conveyor. This prevents a whirling motion in the suction line, as mentioned in the discussion of centrifugal pumps, and also assures that any large solids entering the pump will fall across a conveyor flight where it can be easily cut by the shear bar. The pump shaft is supported by bearings at each end of the pump to absorb the shock of the cutting load. The operation of this pump is quiet. Having no valves, it is free from clogging and ball and flap valve troubles.

Sizing Sludge Pumps

The capacity of the sludge pump used to pump raw sludge from the primary tank to the digester is determined by considering that 1% to 2% of the average design flow will settle out in the primary tank hopper. This sludge should be pumped to the digester in 2 to 3 hours daily

(*Continued on page 92*)

Here is the Lowest Cost Method of Bulk Rubbish Collection Ever Devised



PICK UP, HAULING AND DUMPING operations are shown above. Large photo shows Dempster-Dumpster hauling a pre-loaded 10 cu. yd. container from downtown Nashville to sanitary fill.

You can cut your cost of rubbish collection in the trouble areas of your city in half with the Dempster-Dumpster System! We know this because it is being done in dozens of other cities. This remarkable system comprises one or more truck-mounted Dempster-Dumpsters, each with only one man, the driver, which services scores of detachable Dempster-Dumpster Containers. Containers of various designs range in size up to 12 cu. yds. (two and one-half times the capacity of the average dump truck). The Dempster-Dumpster makes scheduled calls at housing, market and business areas, schools, hospitals, etc. Each pre-loaded container is picked up, hauled to disposal area, emptied and returned. Entire operation is handled hydraulically by means of controls in truck cab.

The Dempster-Dumpster System triples man-hour efficiency . . . reduces truck investment, gas, oil, maintenance costs . . . improves "housekeeping" methods . . . reduces fire hazards . . . provides an easier, quicker, safer and more effective manner of handling bulk trash and refuse.

The cleanliness of the Dempster-Dumpster System is due to the completely closed steel containers. Trash and refuse cannot be scattered over streets and alleys by winds or scavengers. In addition, Dempster-Dumpster Containers are rat-proof and fire-proof! For complete information write today! Manufactured exclusively by Dempster Brothers, Inc.

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REPORTS *from the* FIELD
Better Methods and Equipment

IT IS MY PERSONAL opinion that Abilene derives much dollar value from its Insley shovel and its Allis-Chalmers loader-digger. We buy equipment which we know we can use on a number of activities. In Abilene, the shovel, drag-line or backhoe is particularly useful and economical in keeping the creek channel cleaned out. This creek runs completely across the city. We also use the backhoe in water main and sewer trenching as well as for dirt-moving at the dump. The AC HD-5 loader-dozer has been very efficient in the operation of our sanitary landfill, and in doing other work, as unloading 12-inch pipe; and we plan to use it for laying the pipe. We have also used it for snow removal with improved efficiency and reduced cost as compared to the older equipment previously used—Frank H. Lawlor, City Manager, Abilene, Kans.

A CONTRACT FOR paving 42 blocks of streets and avenues was let by the city of Glasgow last year. Minimum width of these streets was 36 ft. and maximum width was 50 ft. Paving was 3½-inch 2-course hot mix asphaltic concrete. Three Tournapulls were used on excavation and did a fast and economical job with one Caterpillar pusher. We also laid 27,000 ft. of roll type integral curb and gutter, using 900 ft. of steel form. A Dotmar curb and gutter paver was used with excellent results.—Roman C. Fargo, City Engineer, Glasgow, Mont.

OUR COMBINATION dozer and front end loader was used on many types of work, including routine maintenance, sewer and water installations, snow removal and sand loading. While no unusual work was performed, the multiplicity of uses to which we have put our HD-5 AC tractor with Tractoshovel front end loader and dozer is amazing.—Thomas S. Gregory, City Engineer, Beacon, N. Y.

THE REMOVAL OF large trees and stumps after a big wind storm was a problem. We used a Lull shovel loader on a Case tractor. This loader moved whole trees that had some of our main streets blocked. With this machine and a rented chain saw, we saved days of hard work and plenty of money. Also I designed and made a chip spreader which fastens with four bolts under the tail gate of a truck. It is adjustable and spreads wider than the wheels when oiling streets. I have covered better than 5,000 gallons of oil in one 8-hr. day, using 120 tons of stone with one truck.—W. E. Crisman, Street Superintendent, Washington. N. J.

WHEN LAYING large sewer pipe in unimproved streets, we used a dozer to dig a trench the full width of the blade. Our Hough loader was then able to work in this trench with improvised hooks and to lay 42-inch reinforced concrete pipe. This procedure saved many hundreds of dollars.—S. R. Pursel, City Engineer, Phillipsburg, N. J.

A SMALL HOT-MIX asphalt plant, capacity 20 tons an hour, was purchased last year and put to work patching and resurfacing some of our old asphalt-paved streets. The use of this plant materially speeded up patching operations and also made it possible to resurface several blocks which had deteriorated beyond patching.—Paul J. Hays, Superintendent of Public Works, Minot, N. D.

FOR SNOW REMOVAL, we have been using a small tractor with a blade and loader. This equipment, though leased, did more work and did it better than any snow removal equipment we ever used. With it, we were able to keep all of our business section open, including alleys and drives. This work was highly appreciated by our residents. —Frank W. Paden, Jr., Mayor, North Baltimore, Md.

FOR CAR TRACK removal, we have found by considerable experience that a D8 tractor and No. 8 ripper are the fastest and most economical. Using one tooth of the ripper, it takes four passes to complete the job, but 100 ft. per hour can be removed.—P. Greer Johnson, Project Engineer, Asheville, N. C.

A SHOVEL LOADER was used for the following kinds of work: Moving fill, loading material on truck from stock pile, pulling up sign posts and driving posts into the ground, pulling tree stumps and loading them into a truck, and snow removal. It opened roads in snow so deep that a snow plow could not get through. It did rough grading and many other jobs. In my opinion this is one of the most useful pieces of equipment for all-around work throughout the year.—Henry P. Weissenberger, Superintendent of Public Works, Malverne, N. Y.

WE HAVE TWO methods of driving pipe under paved streets. In one of them a 1½-inch pipe is driven either by sledge hammer or air compressor and copper tubing is pulled through the pipe, the pipe remaining in the ground. In the other method, a 1-inch pipe is driven in the same manner and copper tubing is fastened to it and pulled through the soil as the pipe is withdrawn. These methods have been successful except when a large boulder is encountered; also it cannot be used where the width of the paving is greater than the length of pipe, unless one opening is made in the paving. There must be at least 20 ft. of trench to work in within the curb or property line. Because we know of nothing like it on the market, we have developed our own parking meter pipe straightener, which is improvised from a jack and specially made clamps.—Wm. H. Howell, Borough Secretary, Morrisville, Pa.

OUR NEXT PROJECT will be to start a sanitary landfill for garbage disposal, but we do not anticipate doing this until 1952 or later. We have twelve trucks and we usually replace one or two of these a year. In addition we have a couple of jeeps, which are equipped with V planers and used for sidewalk snow removal; also a flusher and a welder. —M. E. Henderson, City Manager, Bozeman, Mont.

WE AVERAGE about 3 gallons of mixed coins, nickels and pennies, each week from our parking meters. In past years it has taken two men nearly two hours to separate the coins by hand on a table. When it fell to my lot to take over the job, laziness prompted me to figure out an easier way. I had holes bored in

2,451,000 Cubic Feet Capacity

IN 10 P.F.T. FLOATING COVER DIGESTERS at North Point Sludge Treatment Plant,

SAN FRANCISCO, CALIFORNIA

A RECENT addition to the long list of P.F.T. Floating Cover Digester installations is San Francisco's North Point Sludge Treatment Plant. Here, ten digesters are equipped with soundly designed, ruggedly constructed P.F.T. Floating Covers, each 100' in dia. "Controlled Digestion" facilities, including full flexibility of piping arrangement, external heating, volatile acids and ammonia nitrogen control, assure dependable, efficient digester operation. These digesters handle all of the sewage sludge for a population of 1,169,000.

There are two batteries of five digesters with a control building for each group, housing a total of eight P.F.T. sludge gas fired No. 1500 Digester Heaters and Heat Exchangers. These heaters are equipped with complete automatic controls to provide constant digester temperatures and heating of the control buildings. Total heater output capacity is 12,000,000 B.t.u./Hr. Other P.F.T. equipment at this plant includes spirally guided gas control holder lift for a 55' 6" dia. tank, floating cover position indicators, and a full complement of P.F.T. Gas Safety Equipment.

Sludge is pumped from the North Point Sewage Treatment Plant, over six miles away as well as from the Southeast Treatment Works, close by. The digested sludge from these ten digesters and from the Richmond-Sunset Treatment Plant is further processed by vacuum filtration and heat drying to provide a valuable supply of fertilizer for California growers. The engineering offices of Clyde C. Kennedy, San Francisco, were consulting engineers.

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sheet metal 1 inch apart, just large enough to allow pennies to fall through, but not nickels. The box is 2 ft. square and slides on runners. I now separate more than 10,000 coins in 15 minutes.—J. A. Wood, City Clerk, Hazlehurst, Miss.

WE DESIGNED a bucket for emptying the sludge digester at the sewage treatment plant. This bucket operates on the principle of a well-cleaning bucket and is 2 ft. in diameter and 8 ft. long. Used with a ½-yd. crane, the bucket made it possible to empty the digester of sludge and accumulated grit, with a minimum of hand labor. Except for the very bottom, it was not necessary for personnel to enter the digester.—M. B. Boyden, City Engineer, Moorhead, Minn.

THE MOST USEFUL piece of equipment we have is a tank wagon that carries 600 gals. of water and can discharge this at the rate of 150 gpm at 150 lbs. pressure. It was originally intended for fire work, but we used it to flush drains and flush back water services that are plugged.—M. F. Gibbs, chief engineer, Farmington, N. H.

WE GET THE MOST use out of our crane and HD-5 AC tractor which has a 1-yd. bucket and bulldozer blade. We do our own sewer and water line construction and have about 31,000 ft. planned for 1951 and 1952. We will do about 20,000 ft. this year, plus curb and gutter and about 90 blocks of seal coat.—C. F. Peterson, Sup't. of Public Works, Greenville, Mich.

WE USE A ¾-yd. crawler type dragline to excavate a trench about 20 ft. wide and 10 to 12 ft. deep. Garbage and rubbish are dumped at the end of the trench and bulldozed into it; then it is compacted by the passage of trucks and by the tractor. Each day's fill is completely covered and the area leveled off. With this system, which we have now used for a year, we have no rubbish fires and very few, if any, rats.—Roy Rubright, City Engineer, Hammond, Indiana.

A STANDARD MFG. Co. R/W saw, power driven, hand operated, has been used for trimming 9 miles of crepe myrtle bushes along our streets. We adjusted this saw to a horizontal position and cut brush down to a height of about 6 ins. To do this work by hand would have taken about two months. We also designed a half-moon hook, with a handle 6 ft. long, for pulling brush out of the area as fast as the saw cut it. Two men were used in this operation. We have also found the Fairbanks, Morse, whirlwind mower to be very satisfactory on our 9 miles of grass plots. We have cut our garbage collection cost in half by the use of an Elgin Refuse Getter mounted on a Dodge truck. By truck haul we make 7 trips to the dump per day. With the Elgin, we make two trips to the dump.—John R. Hellams (Col. USA, Rtd.) City Manager, Avondale Estates, Georgia.

WE HAVE REVAMPED our method of operating our sanitary fill. Our equipment consists of a Caterpillar D6 tractor with Hyster dragline equipment, and one Ford and one International truck, both equipped with Gar Wood packer type bodies. We open the trench the same as in the past. Then we spread one day's collection over the bottom of the trench, packing it with the D6 and covering with earth every day. We have found that by

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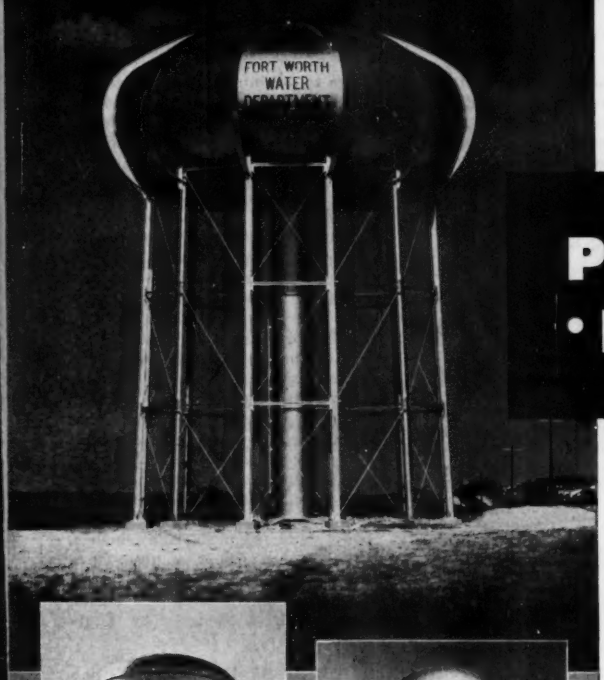

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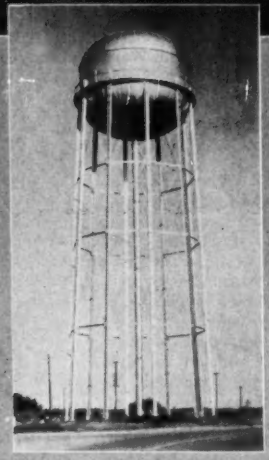

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The Insto-Gas floor-type furnace has all the Insto-Gas features — instant lighting, safety and economy.

This furnace has a melting speed of 40 lbs. of lead in six minutes. It can be used for melting metal, jointing compounds and asphalt.

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Water Works maintenance departments also use Insto-Gas torches for soldering, sweating copper pipe fittings, preheating and thawing.

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spreading each day's collection in thinner layers and thoroughly compacting it, we can increase the capacity of the trench a great deal. Also, by covering each day's collection of refuse, we have reduced the nuisance due to flies and blowing papers.—R. L. Chandler, City Engineer, Newton, Kansas.

USING A SEAMAN Tiller and a motor grader, we have found that we can build mixed-in-place pavement for 80¢ to $1.00 per sq. yd., using 2.5 to 3.0 gals. of RC-2 cutback asphalt, with natural sand and pit shell for stabilizing it. Also, using old parts from other equipment, our men made a muck and sludge pulverizer with a capacity of 3 cu. yds. an hour, with one man feeding. This is driven by a 1½ hp motor. We like it very much.—Fred M. Lowdermilk, City Manager, Naples, Fla.

WE HAVE QUITE a snow problem up in this country. We plow the snow away from the curb with a Caterpillar Grader, pick the snow up with an Oliver tractor with Ware front end loader, dump it into trucks and haul it way.—Gerald Krupp, Street Commissioner, Grand Ledge, Mich.

LAST SUMMER WE purchased a Moline tractor with a front end loader of a half-yard capacity, and a Henry backhoe attachment. This is a great labor saver on house services and small mains. The overall cost for digging and backfilling a trench 20 ins. wide and 5½ ft. deep was 25 cents a foot. We also purchased a 1½-yard bucket for this loader for snow handling and we have saved about half the cost of snow removal over the previous method of hand shoveling and rental of small tractor loaders.—Russell Carlson, City Engineer, St. Louis, Mich.

WE SAVED SOME money and avoided interference with traffic by using a hydraulic conduit jack, capacity 1-inch to 3-inch pipe, for jacking a conduit under a street for a traffic signal. We jacked 80 ft. so successfully that we decided to jack the conduit for street lighting under the sidewalk, rather than tear up the street surface. In doing this, all we had to do was to open the sidewalk for the jack and push a 1-inch conduit 70 ft. each way to the light pole. This saved us considerable expense as we did not have to tear up the street surface at all. Replacement of the sidewalk where the jack was placed was a very small item.—Carl Erickson, City Clerk & Engineer, Alexandria, Minn.

THE MOST USEFUL equipment we have is an Oliver 80 tractor with a Lull front-end loader with ¾-yd. and 1¼-yd buckets. This equipment has been used for loading gravel and snow, for tree trimming, as a small hoist, for sod removal and many other jobs. Its efficiency and versatility make it very valuable for a small city. We also have an emergency sewer truck which has been most useful. A specially built body, which cost $300, is mounted on a ½-ton truck. The equipment carried includes a Flexible sewer rod reel mounted on the side of the body, ladders, picks and shovels, lanterns and 1,000 ft. of hose. On a trailer, we carry a pump and sewer drag equipment.—Joseph Banta, St. Comm'r. & Acting City Engineer, Shelbyville, Indiana.

OUR MOST INTERESTING job last year was the repair of a long-time leak in the city reservoir. The dam is about 40 ft. high and about half way up there was a bad seep. The water was drawn down and a bulldozer used to move out the mud. Eventually an old discharge pipe was uncovered which had about rusted out. This pipe was filled with concrete and new dirt moved back on the dam. This cured our trouble.—H. S. Milam, Engineer, Chelsea, Okla.

USING A TAR-GRAVEL mix, 3.62 miles of street were blacktopped with county equipment at a cost of $2,956.76 per mile. The streets averaged 24.5 ft. wide and the cost per square yard was 22.3¢. County equipment was used for this work, as follows: One booster for loading tar; one bituminous distributor; one tiller; two road oil supply tanks; and four motor graders. The work was done in a 6-day period and the surfacing was 2 to 3 ins. thick.—E. Bruske, Street Commissioner, Stevens Point, Wisc.

A BARBER - GREENE snow loader has been one of our most effective pieces of equipment. Snow is graded to the center of the downtown streets so that which is not picked up during the night can be removed even after cars have begun to park the next day.—Neal Bartholomew, City Engineer, Eau Claire, Wisc.

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Installed in four-120 foot Diameter Filters in new Bethlehem, Pa. Sewage Treatment Plant

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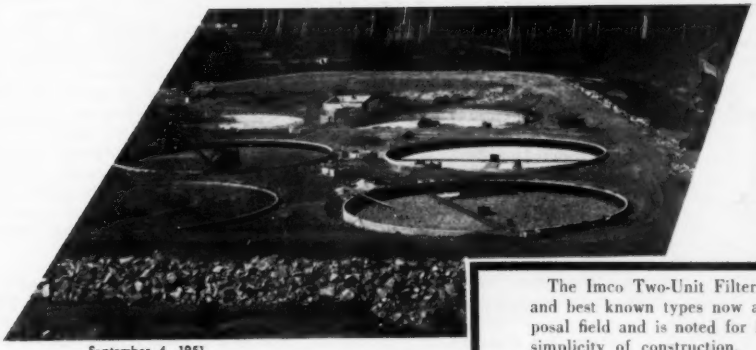
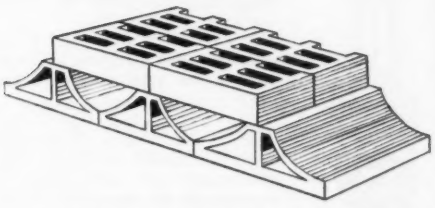


September 4, 1951

R. L. Fox — Bethlehem Authority Engineer

Morris Knowles — Consulting Engineers, Pittsburgh, Pa.

Thompson Construction Company, General Contractor Albany, New York



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The ample cross sectional area of the channels, and the apertures in the block assure an adequate air supply. The area of the channels is 26 square inches, or 64% of the cross sectional area of the filter; while the area of the apertures is 40% of the filter floor area, this being approximately the same percentage opening as the voids in the filter media. (No other filter floor system provides this maximum aeration efficiency).

The grill or top block is three inches thick giving maximum safety to the floor during the process of loading the filter media. (No other floor system provides this margin of safety).

The longitudinal mortar medial joints in the channel blocks are only one inch deep, making a flush joint of cement-sand mortar an easy operation and resulting in a smooth flow line for the liquor.

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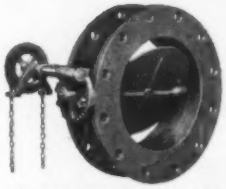
Full unrestricted flow of water, slurries, semi-solids, air or gas, and quick, positive, accurate regulation and shut-off. Built of any metal or rubber-lined. Pipe sizes 1" to 72". Pressure standard to 50 p.s.i. and special for higher pressures. Made for any temperature from sub zero to as high as 1800° F.

Control — Manual: lever, hand wheel, chain wheel, chain lever, etc. Automatic: electric motor, air diaphragm, air or hydraulic cylinder, solenoid, float, or other types, with positioners and special remote control mechanisms, if desired.

Wafer Butterfly Valves — rugged, lightweight, require only 1 set of bolts; sizes 4" to 72"; any type of control.



Flanged butterfly valve with chain wheel control; may also be hand wheel or lever control.

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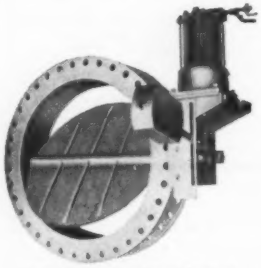
Standard—Made in threaded or flanged 1" to 20" sizes, with pull handle, lever or wheel control. Built of any required metal.

"Kwikleen" Type—For fluids containing solids that clog ordinary valves. Easy to clean without removing from the line by simply removing bottom clean-out plate and blowing or washing out the valve. All manual controls and also with air cylinders. Heavy duty "Kwikleen" Valves are made for 60 p.s.i. operating pressure.



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30" butterfly valve for 60 p.s.i. line pressure; equipped with Limitorque motor operator and auxiliary hand wheel.

Threaded butterfly valve, 1" to 4" sizes, manual or automatic control.

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252 ELIOT STREET • FAIRFIELD, CONN.

Now's the time to mail this month's Readers' Service card.

AN I-6 INTERNATIONAL front end loader was purchased early last year. With this machine we did all of our work involving picking up of material for street construction and repair; and all of our snow removal. It has practically eliminated the need for hand labor on such work. Also, we purchased an old oil distributor and rigged up attachments so that we could pick up used motor oil from service stations and use this for dustlaying on our streets.—S. J. Baudhuin, Jr., City Engineer, Sturgeon Bay, Wisc.

Sewage & Sludge Pumps

(*Continued from page 84*)

pumping time. In determining the head on the pump, the static head will be the difference between the water level in the digester and the average level in the primary sludge hopper or tank. Because of the increased resistance of extremely heavy sludges at the start of the pumping operation the computed friction head should be increased 5 to 10 times. The use of variable speed drives is recommended to overcome the difficulty of moving heavy sludges at the beginning of the pumping period and to provide for pumping the sludge at a slow rate in order to prevent pumping excessive amounts of water to the digester. With extremely heavy sludges it is often necessary to start pumping at a relatively high rate. The rate of pumping may then be reduced to minimize the water pumped to the digester.

Sludge Piping System

The layout of the sludge piping system is of great importance for the successful operation of the sludge pumps. A well laid out piping system should incorporate the following features:

A positive suction head is more desirable than a suction lift regardless of the type of sludge pump used.

The suction line should be as short as possible and should be entirely horizontal or sloped toward the pump or rise vertically and then horizontally into the pump.

The suction line at the point of entering the pump suction opening should never be lower than any other point in the suction line.

The number of bends should be at a minimum.

Foot valves, check valves, and sludge shoes should never be used on the suction side of the pump.

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A combination vacuum and pressure gauge should be provided on the suction side and a pressure gauge on the discharge side of the pump. These gauges will indicate any clogging on either the suction or discharge side and will indicate any build up in pumping head that may be taking place due to sludge caking in the pipe lines.

Pipe sizes on the suction and discharge sides of the pump should be selected to assure velocities of not less than 2 fps in the line. These velocities will prevent settling of the sludge in pipes and allow flushing.

Sedimentation

(*Continued from page 66*)

mergence of the draw-off pipe is necessary.

For final settling tanks after activated sludge aeration, continuous sludge drawoff valves are desirable. A 2-ft. head is ample for such installations.

Sludge as drawn from the hoppers may have a solid content as high as 10%. This means that consideration must be given to additional frictional losses. Channels carrying sludge should slope at least 3% and a friction loss of at least 5 times that of water should be allowed in pipe lines carrying sludge.

Sludge pumps should be located where there will be a positive head on the suction, unless the plunger type of sludge pumps are used. Provision should be made for variation in the pump discharge by means of a variable speed drive or by changing the length of the stroke of the pump plunger. Provision should also be made for the sampling and visual inspection of the sludge as withdrawn from the sludge hopper. The best method of doing this is by means of a sludge well to which the sludge can be withdrawn by gravity and examined during withdrawal. Scum may also be discharged into this well and pumped with the sludge to the digestion tank. When the sludge pump suction is directly connected to the sludge hopper a 2-in. quick-opening sampling valve, with a drain directly beneath, should be provided.

Scum Drawoffs.—The scum which collects on the surface of the tank is concentrated by the sludge mechanism and deposited directly into the scum troughs or in front of revolving scum pipes. The revolving pipes for scum are rotated to

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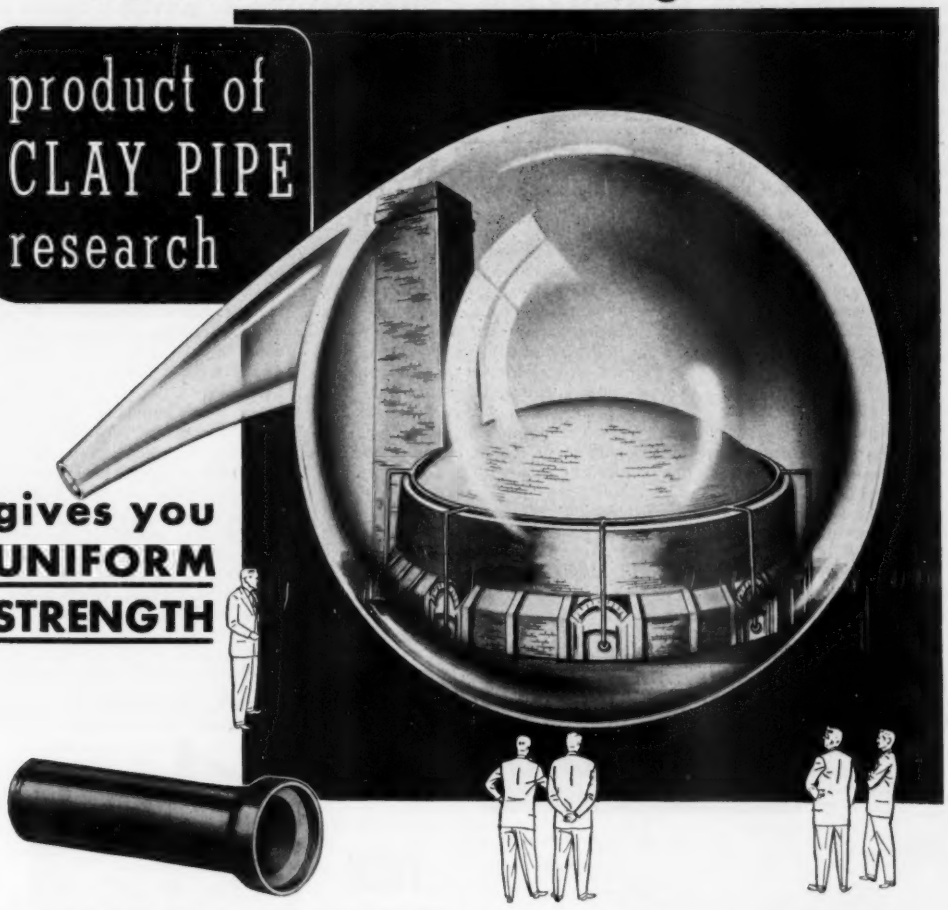

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remove the scum from the tank surface. Usually the scum troughs and rotating scum pipes discharge into a scum pit from which the scum is pumped to the sludge digestion tank.

Floors.—The floors of rectangular tanks are screeded smooth and flush with the top of 20 to 25-lb. tee rails which act as wearing surfaces for the sludge scrapers or flights. The floor should slope about 1% toward the sludge hoppers to facilitate draining and cleaning of the tank. For circular tanks a rough floor is first poured and then a finish floor of 2 ins. of grout is swept in with the mechanism to make sure that the floor will coincide with the path of the sludge collector mechanism.

Results

At practically all newly constructed plants the actual detention periods exceed design detention due to the fact that provision has been made for future anticipated flows. Numerous published data show that a detention period of two hours will give a suspended solids removal of 50% to 60%. Longer detention periods usually are not economical as the increased removals do not justify the additional cost of construction.

An average BOD removal of 30% to 40% can be anticipated by primary sedimentation of an average domestic sewage, with practically 100% removal of the settleable solids.

Screenings and Grit

(*Continued from page* 63)

before its discharge into receptacles. A complication is that all sewage contains garbage, organic seeds, and similar materials which have a higher terminal settling velocity than the smallest grit particle that the grit channels are designed to remove. It is apparent that this class of material must settle out with the small inorganic grit and be removed with it. If the detention period in the grit channel is lowered in order to pass this organic material through the chamber, large sized inorganic grit will pass through the grit channel likewise. A satisfactory and practical solution to this problem is to settle the grit in a channel, remove it to a surge bin, and then put it through a separate grit washer which will scrub, wash and classify the grit.

One of the really satisfactory and efficient grit washers is the Jeffrey Jigrit washer. Washing and classification is accomplished by a pulsating flow of wash water through a perforated plate in the bottom of the washing compartment. This action not only removes the putrescible material from the grit, but classifies the material in accordance with the specific gravity of the particles. The organics and low gravity material collect at the top, where they overflow with the wash water. The inorganic grit and high gravity solids settle to the bottom, where the oversize particles build up a bed of coarse material. The fine grit passes into a lower compartment where it is removed by a spiral conveyor or elevator. When the coarse grit bed becomes too deep, an ejector is operated to draw this off into the lower compartment. The overflow from the washer, which contains organics and light gravity solids, is discharged at the effluent end of this grit channel. The operation of such a grit collector and washer is simple. During normal conditions, the grit collector is operated by a timer so that

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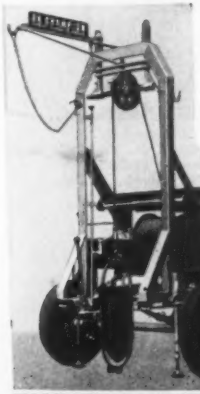

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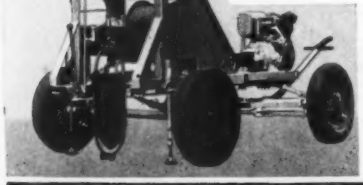

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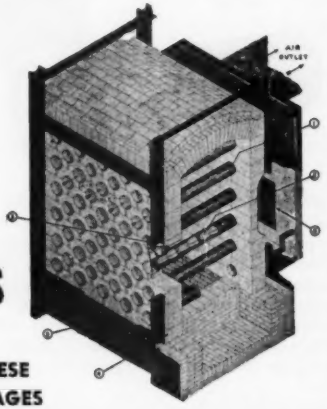

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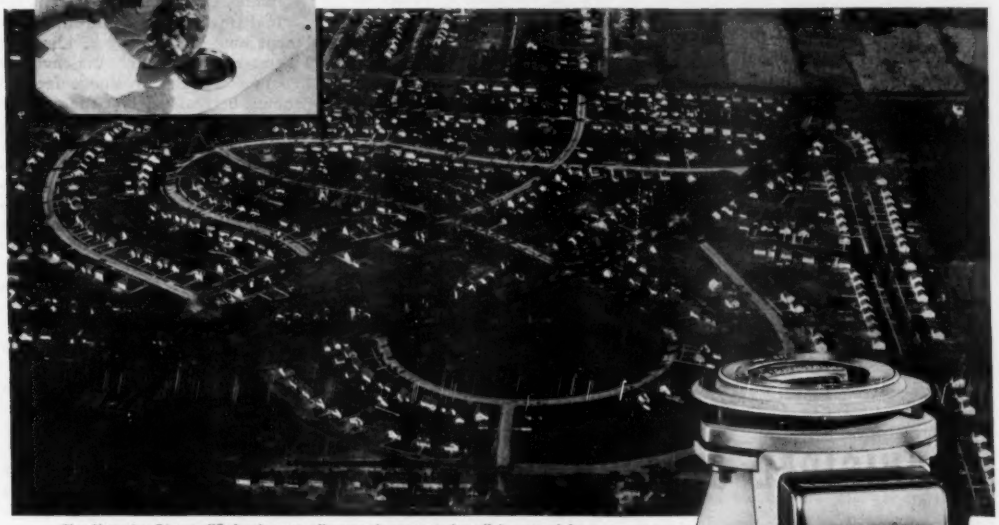

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- **More digested sludge for fertilizer.**
- **Elimination of food-waste before it becomes garbage.**
- **Elimination of alley garbage can.**
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the grit is removed from the channel several times a day, dewatered as it is removed and stored in a bin. Once a day, the spiral in the bottom of this bin is started and run until all of the grit is washed. This usually takes less than one hour. Grit from this type of washer is entirely satisfactory to use for a fill anywhere. It contains little putrescible matter, very few organic seeds, and is almost all inorganic matter. Comparison of the washed and unwashed grit shows clearly the results obtained from this washer.

Sludge Digestion

(*Continued from page 71*)

for the types of treatment listed, and moisture contents of the various types of sludges obtained from the listed methods of treatment were used, as indicated, to obtain the relationship in the calculated values contained in this table.

It is evident that if other basic factors are used, there would be a change in the relationship between the values in the three main subdivisions of the table. For instance, if instead of the assumption of 0.20 lb. of total suspended solids per capita in the raw sewage, a value of 0.25 lb. is used, the raw solids loading factors in columns 1 to 5 and the displacement time in days of columns 9, 10 and 11, would be increased 25% in comparison with the cubic feet per capita values of columns 6, 7 and 8.

The values for the "Displacement Time in Days" as contained in columns 9, 10 and 11 represent the actual theoretical liquid displacement time obtained by dividing the digester volume by the average volume of wet raw sludge feed. It should be realized that the average retention time for solids undergoing digestion would be considerably greater than the liquid displacement values, solids undergoing digestion being retained in the digestion system for periods as much as 50% to 100% greater than those given for displacement time. The effective digestion period, in some methods of calculation, is more definitely related to the retention time in the digester system of the solids undergoing digestion.

Where the composition of the sewage to be treated has been capacity may be computed from established, the digestion system lb. of tota suspended soilds per sludge to be digested, including the proper allowance for storage of digested solids in accordance with the method of final disposal.

In the majority of designs, the digestion capacity is determined on the basis of the equivalent population contributing the sludge solids. Cubic feet per capita values are given in column 6, 7 and 8. "Tentative Standards for Sewage Works" (16) indicate the following unit capacities, in cu. ft. per capita: Primary treatment, 2.0 to 3.0; primary treatment and trickling filter, 3.0 to 4.0; primary treatment and high rate filters, 4.0 to 5.0; and activated sludge, 4.0 to 6.0.

The ranges of these values are indicated by the cross-sectioned areas in columns 6, 7 and 8 of Table 1. One of the State Boards of Health has stated digestion capacity requirements, corresponding with the values in column 5, to be, for primary treatment 25 cu. ft. per pound of volatile added per day; and for activated sludge 30 cu. ft. It will be noted that these values are comparable to the cubic feet per capita value previously referred to.

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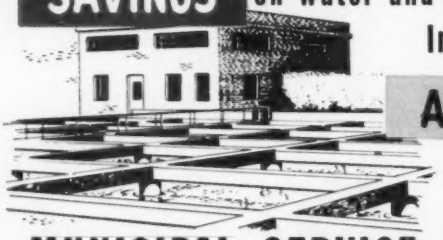

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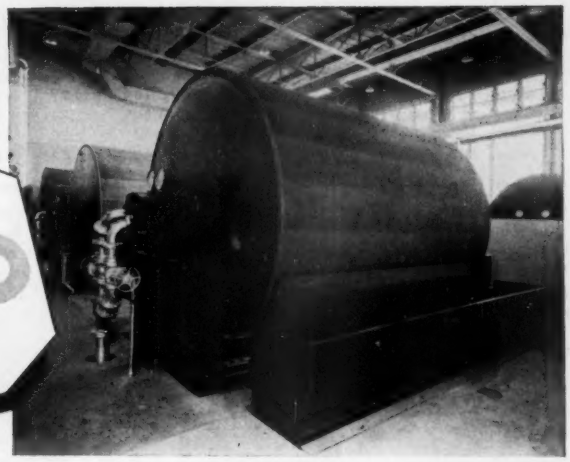

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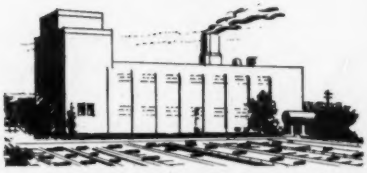

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TABLE 2.—DIGESTER LOADINGS, POUNDS PER CU. FT. FOR 30-DAY PERIOD.

Plant	No. Digesters	Date	Total #/CF	Volatile #/CF	% Volatile Reduction
Cedar Rapids, Ia.	3	Yearly	6.10	4.71	76.0
Cleveland (Westerly)	6	1940	4.00	2.70	52.4
Peoria, Ill.	3	1939	3.20	2.30	49.7
Akron, O.	2	1939	3.10	2.00	52.3

values of the range of unit capacities set up by such requirements will provide a liberal digestion capacity. A survey of operating plants indicates effective digestion of sludge solids at loadings two to three times the above requirements. Such high loadings have been handled for many years with acceptable reductions of volatile matter. Data for a few of these plants are given in Table 2.

At some of the plants, loadings for a one-month maximum period have run considerably higher; for instance, at the Cleveland Westerly Plant in 1933, loadings ran as high as 5.43 lbs. total solids and 4.23 lbs. volatile solids per cu. ft. per 30-day period.

It is believed that by careful control of the digestion system on the part of the operating personnel, it will be possible to effect a reduction in the capacity requirements as presently established by State Boards of Health without sacrificing the effective destruction of organic matter, thus reducing quite appreciably the cost of digestion installations, and the total cost per pound of solids destroyed.

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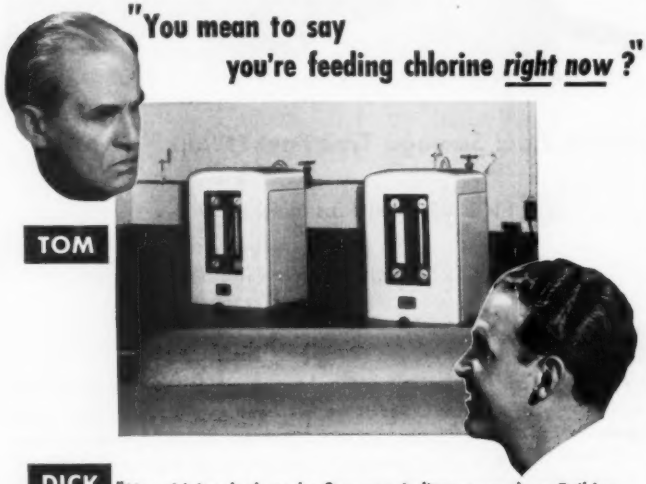
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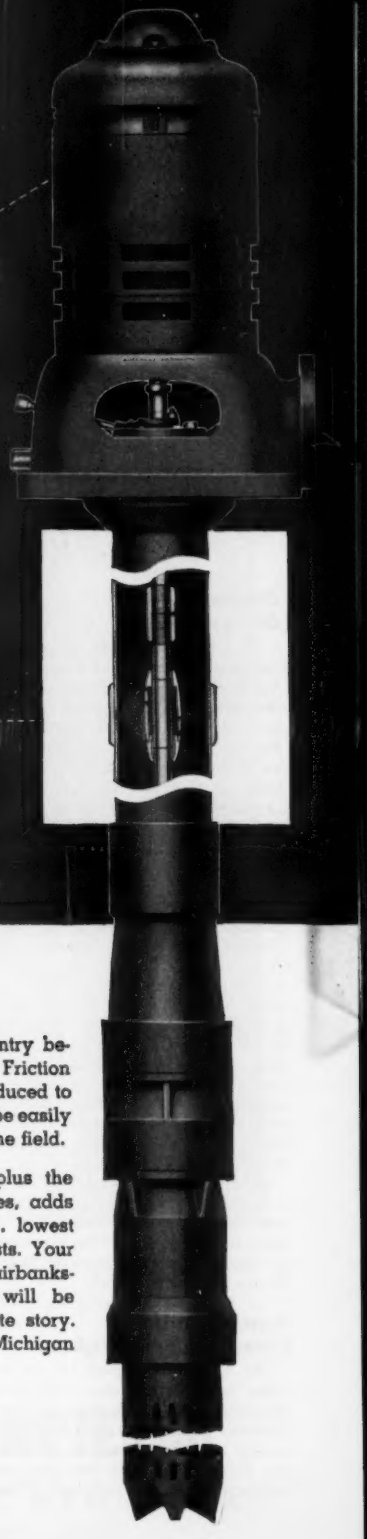

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PUBLIC WORKS DIGESTS

THIS section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of all principal articles in these publications.

WATER WORKS . . 102
HIGHWAYS AND AIRPORTS . . 108
SEWERAGE AND REFUSE . . 114

THE WATER WORKS DIGEST

Chlorination Of Phenols

The author studied the effect of variable controlled chlorination on the taste phenol; o, m and p Cresol; Naphthol, chlorophenol; and di-, tri-, tetra- and penta-chlorophenols. He concluded that chlorination beyond the breakpoint, with sufficient time allowed for reaction, resulted in substantially no "chlor phenol" tastes. The indication is that true free residual chlorination, in which all reactions that consume free chlorine have been allowed to occur, will eliminate the "chlor phenol" tastes caused by the compounds studied. A system must show a truly stable free chlorine content, however, as shown by either electrometric evidence or the p-aminodimethylaniline flash test. In various partially chlorinated systems, which show a positive reaction to orthotolidine or starchiodide tests but do not actually contain a real stable free chlorine residual, the "chlor phenol" medicinal tastes occur.

M. B. Ettinger and C. C. Ruchhoft—"Effect of Stepwise Chlorination on Taste- and Odor-Producing Intensity of Some Phenolic Compounds;" *Journal American Water Works Association*, July.

Payment for Utility Changes in State Highways

The cost of changing mains and other utilities in state highways necessitated by work done by State Highway authorities has become a matter of major concern to utilities. In order to learn how this cost is allocated in the different states, the author sent a questionnaire to every State. From replies to this he learned that, in the great majority of states, payment of the cost of changing utility structures on highway projects is exacted from the utility; except that, if the utility acquired the right-of-way before the highway agency, the cost of changing the utility structures is the obligation of the state. Legislation or constitutional revisions will generally be required to change the present practice. The practice generally is the same for all utilities, both publicly and privately owned. Many waterworks men take serious exception to paying for such changes; and it is recommended that executives carefully consider the problem from the standpoint of what is right and equitable, and assemble facts and figures to substantiate their reasoning and show the magnitude of the problem, and make these public by every available method.

Harry B. Shaw—"Payment for Utility Changes in State Highways;" *Journal American Water Works Ass'n*, July.

Fog Nozzles For Dispersing Chlorine

Should a chlorine leak occur, it should be stopped as soon as possible. If the leaking chlorine could be dispersed or absorbed from the atmosphere, it would enable personnel wearing canister-type masks to investigate safely and correct the cause of the leak. The utility of standard fire department fog spray nozzles for this purpose was investigated in Baltimore, Md., and the conclusion reached that dispersion of chlorine can be accomplished by this method, but absorption can not be accomplished effectively. The method is considered suitable for emergency use when limited to reducing and restricting the concentration of chlorine in air. When the chlorine concentration can be sufficiently reduced, it is possible to approach and repair a leak. When the concentration can be restricted, it is possible to confine a hazardous condition. Accordingly, the Baltimore fire department has authorized equipping all pumper engines, in areas where chlorine storage exists, with two fog nozzles instead of the one normally carried. But this method is not a substitute for permanent ventilation facilities designed to withdraw air and chlorine gas from a chlorine storage room at floor level.

Edw. S. Hopkins and Harry A. Faber—"Chlorine Dispersion With Fog Nozzles;" *Water & Sewage Works*, August.

Removing Radioactive Contaminants

The U. S. Public Health Service, the Tennessee Valley Authority and the Atomic Energy Com'n. are cooperating in conducting field surveys and experimental investigations the aim of which is to better define the problems of radioactive waste disposal and aid in the development of measures for the alleviation or control of such problems. In this connection an experimental treatment plant of 250 gpd capacity is being operated to learn what success conventional processes have

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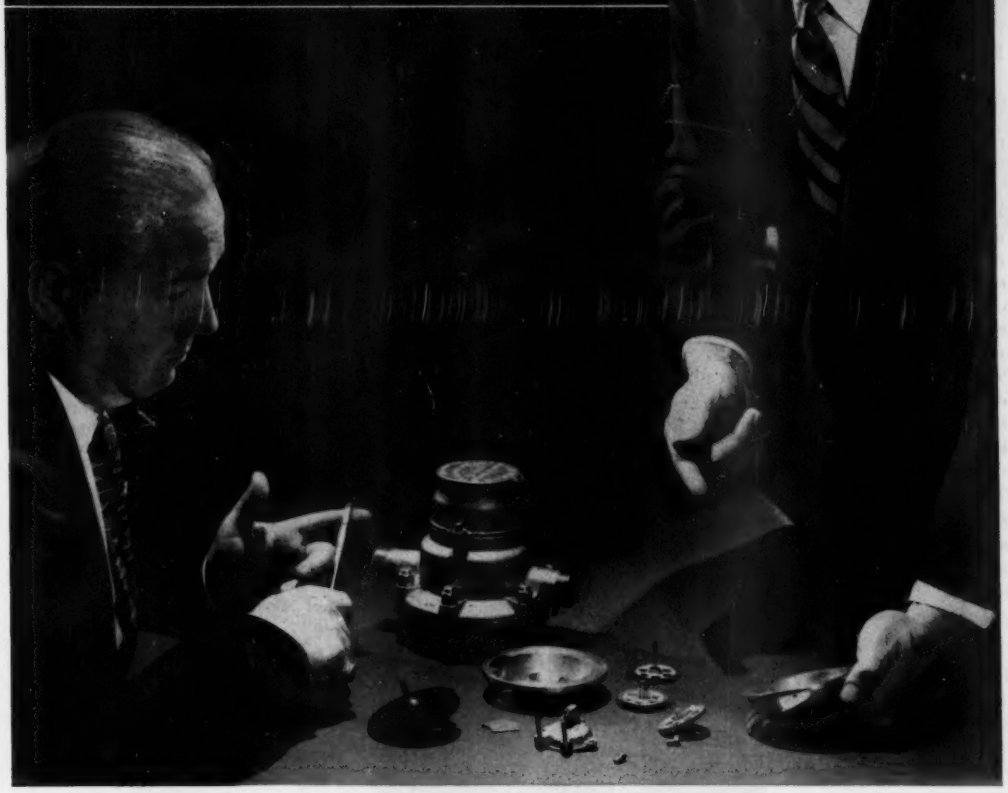

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in removing radioactive contaminants from water supplies. The results obtained by coagulation and settling followed by filtration, vary with the elements and fission products in water following a bomb blast, which may be numerous. In this investigation, the isotopes studied were those of cerium, strontium, yttrium, antimony, zinc, wolfram, zirconium and niobium. The percentages of these removed by settling and filtration in the pilot plant ranged between 43 and 93%. But percentage removals as such are of little significance; it is the final concentration of contaminating material that remains after treatment that determines the success or failure of the process investigated. Study is being made of the use of anion and cation exchange materials; also of clay and activated carbon to determine their effects in removal.

Conrad P. Straub, Roy J. Morton and Oliver R. Placak—"Oak Ridge Reports Results on Water Decontamination Study;" *Engineering News-Record*, Aug. 16.

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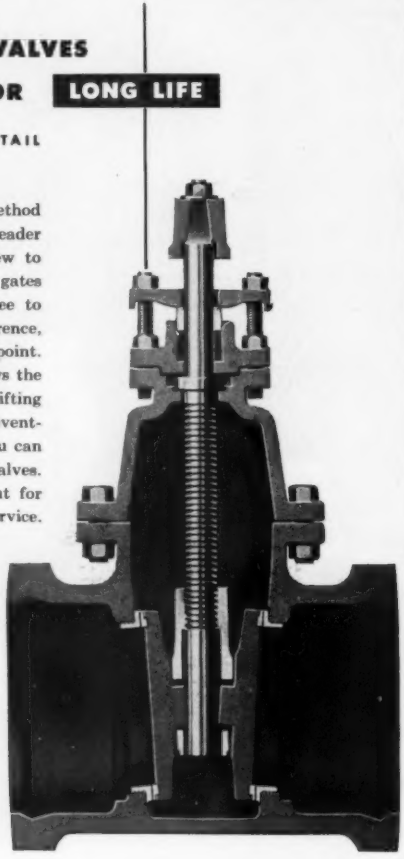

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Microorganisms in Streams and Reservoirs

It is often neither practical nor desirable to eliminate microorganisms in streams or reservoirs; rather, the number and kinds should be so controlled as to preclude such troubles as blooms, tastes and odors, and clogging of filters. Algae sometimes kill fish and cause illness or death to cattle; on the other hand they liberate oxygen into the water and thus stimulate self purification, and they are a basic constituent of food for fish. The biological productivity of reservoirs is affected by the amount of organic material washed into them from marshes, fertilized fields, eroded top soil etc. Narrow, deep reservoirs are not as productive as wide, shallow ones. Reservoirs should, if possible, be impounded during the winter months, covering shallow areas before there is extensive growth of grass or shrubs; and these should be kept covered as long as possible. Removal of water from the bottom of the reservoir instead of the surface prevents stratification, with anaerobic decomposition in the bottom strata, which are brought to the surface during the spring and fall overturns. The operation of a reservoir should be so regulated as to limit water fluctuations and maintain ecological conditions favorable to permanent aquatic populations of the climax type so that short-life populations are kept within bounds, since blooms of the latter may develop rapidly when their natural predators and competitors have not yet become established.

C. M. Tarzwell and C. M. Palmer —"Ecology of Significant Organisms in Surface Water Supplies;" *Journal American Water Works Ass'n*, July.

Production of Chlorine by Utilities

Of the approximately 10,000 tons per day of chlorine produced in the United States, only 3½% is used for sanitation purposes, and it is not profitable for manufacturers of chlorine to ship into Florida in less than carload lots. Because of the apparent chlorine shortage and increase in cost, the Utilities Com'n of Orlando, Fla., which uses over 140 tons a year, investigated the feasibility of constructing a small chlorine plant. It found that a 1-ton-per-day plant can be constructed economically in conjunction with its power and water plant, amortizing the investment over a period of 6 to 10 years.

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Seven Layne Well Water Supply units, each testing around 8,000 gallons per minute, have been installed to furnish cooling water for a power project at Key West, Florida. Permanent installations will be Layne Vertical Turbine type Pumps, each having a capacity of 2,300 gallons per minute. Preliminary tests indicate that efficiency will be much higher than promised.

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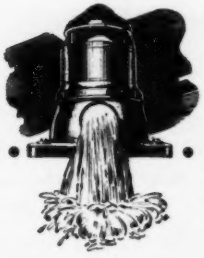

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Experience with manufacture of chlorine by the Sacramento, Calif., Dept. of Water & Sewers since 1924 led to the conclusion that local production of chlorine and its control is relatively simple and requires inexpensive raw materials. Plant maintenance requires permanently available skilled and experienced mechanical and electrical help. Individual circumstances, economically evaluated, must be the basis for determining whether purchased or locally produced chlorine is to be used.

Charles A. Black and Carl M. Hoskinson — "Studies in Local Production of Chlorine;" *Journal American Water Works Ass'n*, July.

Controlling Taste and Odor with Free Residual Chlorination

Before 1947, Nyack and Ossining, N. Y. treated their water with aeration, coagulation, sedimentation, filtration, chlorination, ammoniation and, at times, the addition of as much activated carbon as possible. They experienced both regular and sporadic outbreaks of taste and odor, and in 1947 attempted to eliminate these by breakpoint chlorination and superchlorination. General improvement was obtained, but in a few months rank taste and odor occurred several times, and superchlorination was abandoned and a new method adopted. Sufficient chlorine was applied to obtain a residual of a full 4 ppm in the filtered water after a contact of about 4 hr. This was then reduced by dechlorination with sulfur dioxide to about 0.3-0.4 ppm. The incidence of objectionable tastes and odors has been reduced considerably; color has been bleached from as high as 35-45 to 3-10 ppm, and turbidity has been reduced to a satisfactory level by filtration alone. Both plants operate without the addition of any primary alkali, coagulant, ammonia or activated carbon. Chlorine dosages have varied from 8 to 18 ppm. In order to assure uniformity of residuals it is desirable, if not essential, to install a continuous chlorine recorder. One used at Nyack automatically controls the sulfur dioxide machine. The increased cost of chlorine and sulfur dioxide just about offsets the reduction in cost of ammonia, activated carbon, alum and alkali. The operation of the plant is greatly simplified.

Thomas M. Riddick—"Controlling Taste, Odor and Color with Free Residual Chlorination;" *Journal American Water Works Ass'n*, July.

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Deep Well Pump Maintenance. By *Harry W. Thomas*, Sales Engr. August, Pp. 638-640.

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Engineering News-Record

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There's an Easy Way Out of Your Pipe-Network Woes. By *Malcolm S. McIlroy*, Prof. of Elect. Eng., Cornell Univ. Aug. 30, Pp. 35-36.

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Backhoe, Tractor Shovel and Derrick Speed Up Work and Reduce Costs. By *Theodore L. Cate*, W. W. Supt., Laconia, N. H. September, Pp. 44, 91

Two-Way Radio in Water Department Operation. By *J. E. Williams*, Water Supt., San Angelo, Tex. September, P. 50.

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The Surveyor (England)

Construction of Prestressed Concrete Tanks at Hartlepool. Aug. 18, Pp. 519-521.

Settling Tank Performance

With an average detention time of 1.3 hours, 70.9% of the suspended solids and 38.3% of the BOD were removed at the Minneapolis-St. Paul sewage plant during 1950. Detention at the design flow of 134 mgd is 2 hours; at maximum flow of 610 mgd it is 26 minutes. Sludge is pumped from the tanks three times in 24 hours. Solids concentration averaged 7.75% during 1950, ranging from 5.4% to 16.4%.

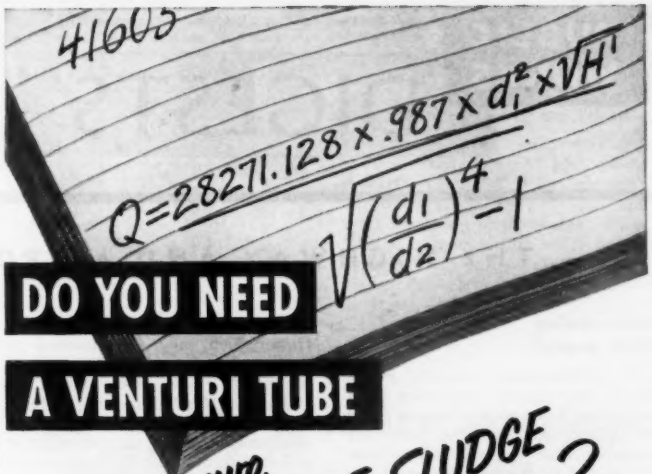
Cleaning Sewers in the Missouri River Flood Area

The cities of Manhattan, Topeka, Lawrence and Hays, Kans., have contracted with Smith & Loveless Norcam of Kansas City for removing debris deposited by the recent floods in sewer mains. One of the largest single jobs is that for Topeka, which will have to clean 450,000 ft. of sewers, ranging in size from 6-inch to 108-inch. The work is to be done in 90 days.

Collects "Joining Fee" for Areas Annexed to City

Since February, 1950, Pasadena, California, has received $108,675 cash-on-the-line paid by citizens of three unincorporated fringe areas for the privilege of annexing to the city. Applications from six other areas containing 14,000 people are pending. The "joining fee" for these six areas will be $903,900 on the basis of $100 for each 50 x 150-foot lot. In addition to the joining fee, the city charges $250 an acre for water and $1.25 per foot for water mains on annexed land that is uninhabited.

The annexation fee has proved sound from the point of view of the city. Property owners of annexed areas who cannot make payment in cash may retire their obligation over a period of years at rates fixed by the city.—Public Management.



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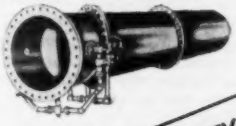

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PUBLIC WORKS DIGESTS

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Undersealing With Asphalt

In undersealing concrete pavement, the ordinary procedure is to drill 1½" holes at intervals of 10 to 20 ft. and wherever the pavement sounds hollow, but seldom less than 18" to 24" from any joint or crack. The system of drilling finding most favor at present is the air-lift type drill mounted on a pneumatic wheeled tractor carrying the compressor. The asphalt is normally applied by means of a standard highway asphalt distributor with a capacity of 500 gal. or more and equipped with a rotary positive-pressure-type pump and full circulating asphalt delivery line. For introducing the asphalt through the hole, several devices are in use, such as the "asphalt gun" illustrated herewith. If water is present under the slab, it is advisable to use pumping pressures slightly higher than the ordinary 30-40 psi, and hotter asphalt than the ordinary 400° F. Costs of undersealing vary with the hardness of the concrete, age and condition of the pavement, amount of rainfall and subdrainage, and other factors. On the average there will be 300 to 700 holes per mile, with 10 gal. of asphalt per hole. Drilling, blowing and grouting the holes cost 10 to 30 cents per hole, asphalt from $1.50 to $2.50 per hole.

Walter F. Winters—"Undersealing Concrete Pavements with Asphalt;" *Roads and Engineering Construction*, August.

Asphalt Plant For 5,000 Tons of Mix Daily

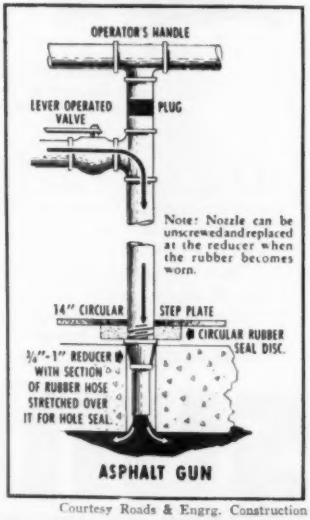
Two construction sections of the New Jersey Turnpike with a total length of 46 miles are being supplied from a single asphalt plant. To meet the contract date, this plant must supply an average of 25,000 tons of mix a week, rain or shine. The plant is built around four 2-ton batch plants. Aggregates are dozed onto four 192-ft. belt conveyors, which feed four cold stock bins, from which they are elevated to driers. Four aggregates — sand, screenings, ⅜ in. stone and ¾ in. stone—are blended and dried. Belts, elevators, driers, pugmills and other mechanical units are electrically powered throughout. Asphalt is supplied by four 10,000 gal. tanks, each mounted on low-bed trailer frames to permit quick departure when empty. These are expected to supply a top schedule of 50,000 gal. daily of 85-100 penetration asphalt. There is an inspector on each of the four plant units and a large field laboratory.

"Paving 46 Miles of Turnpike from a Single Plant Set-up;" *Roads and Streets*, August.

Causes of Poor Seal Coat Jobs

Poor results from seal coat jobs may be due to one or more of the following: A—Poor initial adhesion of aggregate or non-uniform texture, due to insufficient film of bitumen; or too great range between max. and min. sizes of aggregate; or dirty aggregates, or those that resist adhesion because of their nature or because too dry or too wet; or viscosity of bitumen is too low; or slow setting rate of cut-back or emulsion; or wrong grade of bitumen; or unfavorable weather conditions. B—Poor non-skid qualities of treatment, such as too high application rate of bitumen; excessive flatness of aggregate or tendency to polish excessively under traffic. C—Poor service life, because aggregates are too friable or possess poor resistance to weather; or excessive hardening of bitumen; or poor resistance of aggregate-bitumen combination to stripping. D—Poor construction practices, such as improper preparation of surface to be treated; or non-uniform application of bitumen or of aggregate; or bitumen too cold when aggregate is applied; or segregation of aggregate into large and small sizes; or improper rolling; or poor traffic control during and immediately after construction. E—Poor or infrequent patching.

"What Makes a Good Seal Coat Job;" *Roads and Streets*, August.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Flagging Traffic Through the Job

Since 1938 certain standardizations of signals for regulating traffic past construction work have been incorporated in Minnesota Dept. of Highways construction contracts. Recently modifications of these regulations have been recommended by a committee composed of official representatives of the Associated General Contractors of Minnesota and the several department heads of the highway department and their assistants. Among the adopted modifications are the following: Job signs carrying the contractor's name and address are placed at each end of a project. All flagmen, while on

duty, must wear a white "Sam Browne" belt. All flagmen considered necessary for satisfactory service to traffic are paid for at the state's expense under a contract item "Flagman-hours." Signs and barricades are maintained in the immediate vicinity of the work and removed as soon as no longer needed or pertinent for safe traffic control.

C. L. Methven—"Safer Traffic Flagging Through the Job;" *Roads and Streets*, August.

Connecticut's Sight Distance Survey

The Connecticut State Highway Dept. has completed the field work for a sight distance survey of the 3,000 miles of the state system. The information will be used to determine locations where sight distances are inadequate, and for setting code markers along the highways to enable the operators of center line striping machines to adjust their paint sprays for solid or dashed lines as required for straightaways, hills and curves. A survey is made by a pair of cars, each equipped with a two-direction radio and an odometer, and the leading car with a white light on its rear bumper. The rear car stops at a selected point while the front car moves ahead until its rear light is no longer visible from the stationary car, when the latter stops it by the radio. The odometer readings give the sight distances.

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Undersealing Concrete Pavements with Asphalt. By *Walter F. Winters*, Chf. Engr., Asphalt Inst. August, Pp. 100-101, 105-106.

Roads and Streets

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Chloride Feeder Supplies Paver Drum. August, P. 43

Use of Radio by Highway Departments. August, Pp. 48, 50-52.

Contractor Sets Fast Pace on Oklahoma Soil-Asphalt Job. August, Pp. 72-73.

Bituminous Undersealing Practice (in several states). August, Pp. 76-77.

Paving 46 Miles of New Jersey Turnpike from a Single Plant Set-up. August, Pp. 63-66, 68-69.

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A Centrifuge Method for Analyzing Road and Building Asphalts. By *D. C. Broome* and *G. E. King*. August, Pp. 216-219.

Excavations Must be Filled

Excavations left unused for 6 months are declared to be a public nuisance under a new ordinance adopted by De Pere, Wisc., and must be filled and leveled. Upon failure to comply with these provisions the city will do the work and charge the cost as a special assessment.

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How Pest Control Operators Can Serve in Civil Defense

LOCAL conditions and seasonal factors will determine how important the problems of pest control will be to Civil Defense. Even where pest control will be needed to protect public health, some delay in applying control measures will be permissible. Also, the personnel and equipment required for control will usually be in excess of local resources. For these reasons, utilization of pest control operators and of the resources of the pest control industry is best made on a state wide or regional basis.

The factors covering the utilization of pest control operators has been outlined in a bulletin issued by the National Pest Control Association, on which much of the data in this article are based.

The most effective place for pest control operators in Civil Defense is as specialists in rodent and insect control, attached to and part of the State Civil Defense organization; and not to local area or city defense groups. Local pest control operators, working individually would be inadequate to render the required services if these services were needed. On the other hand, pest control operators will be valuable to advise local defense councils. However, as outlined later, they should not participate as individuals in the local defense setup.

Inventory of Equipment and Manpower

Working through the State Association, or through a regional or even temporary group representing the pest control industry, a first step should be an inventory of manpower and equipment. The manpower inventory may begin with an enumeration of the men available and qualified in each establishment. There must be assurance that each of these men is willing to serve and determining this is a function of the head of each establishment. To have reliable records in this respect, it is desirable that all data in respect to personnel be in written form.

The equipment inventory should show: (1) How many cars or trucks are available including cars of employees, if applicable; (2) how many heavy-duty sprayers or foggers are available, as Tifa, Bean, Dynafog, etc.; (3) how many light sprayers can be furnished; and (4) what supplies are on hand or normally carried, as DDT concentrate, Warfarin, etc. If desired, a monthly report on such materials can be rendered; but if Civil Defense stocks these agents, the supplies carried by the pest control operators are less important. They may, however, be relied on for the initiation of the work.

The Pre-Emergency Program

Assuming that organization has been accomplished through a state or other suitable pest control organization, and that arrangements have been made with the State Civil Defense Organization for participation in the program, pest control operators have an important part in the pre-emergency program.

In this, the organized pest control operators may be called on for regular inspection and treatment of

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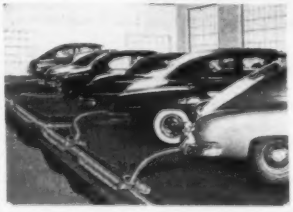

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storage facilities for medical, food and clothing supplies that are in the care, custody and control of local, State or Federal Civil Defense authorities. These services may be rendered in a variety of ways. The National Pest Control Association suggests that these services be donated by the profession. The extent to which this is done should be governed by policies in effect in other similar activities. The services of the pest control operators may be wholly without charge; inspection may be free and materials paid for by the Civil Defense agency; or regular payments may be made. Obviously, few pest control firms could afford to treat large scale installations for any extended period without some compensation for materials and labor.

The association also suggests that free regular inspection and treatment be provided by pest control operators for bomb shelters which have been built for this purpose only, and which have no other peace-time use.

In the emergency period, after an attack, there are numerous duties that pest control operators can perform. It should be remembered that many such operators are highly trained scientists, as entomologists or biologists and, as such, can work in a wide field of activity.

One important service that pest control operators could perform would be the control of rodents and insects in damaged but usable buildings. Another service would be the control of flies around first aid and casualty stations and at areas of mass feeding, especially open-air feeding places.

The pest control operators could also supplement local food inspection service, since no health department is likely to have enough sanitary inspectors for such work. Refrigeration and other food preservation facilities are likely to be affected, and intensive food inspection and control may be needed.

There may be situations when large scale fly, rodent or mosquito control programs will be required. For the most part, the decision as to the need for these is a responsibility of the Civil Defense health director; and where needed, a reasonable time will be available in which to initiate the program.

Pest control operators should not volunteer to serve as air-raid wardens; such work should be done by persons without such special skills as the pest control industry possesses. The same is true of many other Civil Defense activities. For instance, it is undesirable to have pest control operators serve on decontamination squads. There are not a large number of pest control operators and they should, so far as possible, be utilized in the field in which they have specialized knowledge and experience.

In at least one state, pest control operators have been enlisted in another type of pre-emergency work. They are watching for any unusual mortality among rats or mice which cannot be attributed to normal conditions; and they are on the lookout for the appearance of insects, hitherto unknown in the area.

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lower 3,000 feet of street by 28 ft. We did this to avoid sheeting a sewer 36 ft. deep. Both a 24-inch sanitary sewer and a 54-inch storm sewer were laid in the trench by open excavation. The surplus dirt was used to fill in around a mucky lake adjacent to the site of the work; and one large dump was filled and eliminated. The estimated saving of doing the work this way as compared to the alternate sheeting method was $40,000.

Result: Two sewers constructed; one lake reclaimed for recreation and park area; one dump eliminated; and sewerage service made available to a large area of our city.

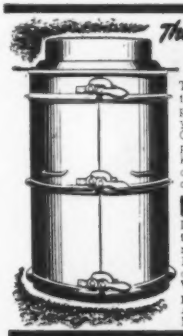
Special Street Cleaning Tax

The cost of snow removal, ice control and street cleaning is charged against the abutting property by Toledo, O. In 1950 the average cost per front foot for these services was 20 cents. This was collected as a special tax. Seasonal service includes placing ice control materials on all major thoroughfares, all streets in the central business area, and at steep grades and hazardous curves; complete snow removal in the central business area and plowing on all major thoroughfares; sprinkling and cleaning all streets in the central business areas each night and all residential streets once a week. This method of financing street cleaning work has been in effect for several years, and according to City Manager Arnold V. Finch has good public acceptance.—Public Management.

BUS AND TRUCK COMPANIES APPROVE ROCK SALT FOR SNOW AND ICE CONTROL

ONE of the great advantages of coarse rock salt is that it makes possible fast and complete snow removal, so that snow doesn't have to be left in piles along curbs, where it blocks traffic. A survey of bus and trucking companies made by the Ice Removal Bureau revealed that these snow piles create one of the biggest problems for transportation firms. One company reported that time and money lost runs into "thousands of truck hours" because snow plowed and left in piles along curbs "makes one lane out of narrow streets, causing our trucks to wait for others." In addition to such delays, this company pointed out that it "takes more time to move freight over a snow or ice bank in front of a receiver's door" and that, even so, trucks are often not able to stop close to the delivery point when snow piles are left in the way.

Bus operators reported that such piles seriously hamper the loading and unloading of passengers, and both truck and bus companies pointed out that snow shoveled from sidewalks often freezes along the curb and further interferes with their efficient operation. When this condition is not corrected with rock salt, one bus company has to reduce its schedules 50 per cent every time it snows or sleets and suffers a proportionate reduction in income and an increase in overhead. Another reported that "at times it takes an hour to make a 15-minute trip."



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Now's the time to mail this month's Readers' Service card.

In Atlantic City, N. J. the Jitneymen's Association, providing local transportation service, wrote to the Department of Public Works, thanking them for the "fine work you did (with rock salt) in keeping Pacific Avenue clear after the last snow storm. This cooperation has met with very favorable expression from our members and passengers."

The Connecticut Company, operating buses in Hartford, characterized that city's use of coarse rock salt as "the greatest thing that ever happened to the city" because Hartford was the only city in that territory where the buses ran without interruption all winter long.

In Rochester, N. Y., coarse rock salt, spread on 367 miles of streets, saves approximately half of the money formerly spent on snow removal operations, keeps streets safe and snow-free at all times, and enables the Department of Public Works to give better all around service to drivers and pedestrians alike. Many other cities report similar facts.

Sewage Treatment Plant Serves Metropolitan Area

Eugene, Oregon (35,672), is building a sewage disposal plant at a cost of $1,100,000. It is located two miles northwest of the city and is designed to serve a population of about 300,000. Eugene will own and operate the plant and will contract with other cities and districts for sewage disposal. Prior to the construction of the plant the cities of Eugene and Springfield (10,771) undertook a joint survey to determine the most economical method of collection, treatment, and disposal of domestic sewage and industrial wastes for the two cities and for 43,000 acres in the area immediately surrounding the two cities. In addition, the seven water districts outside the city, the city and county health department, and the state sanitary authority participated in the survey. The sewerage system is being financed through sewer service charges of $1 for the first 10,000 cubic feet per month with graduated scales of $1 per 10,000 cubic feet for the next 40,000 cubic feet and a $1.40 per 10,000 cubic feet for all water over 50,000 cubic feet. The service charge is collected in connection with municipal water and electric bills. Water districts outside the city also are paying a proportionate share of the sewer service charge based upon the metered water used.—*Public Management.*

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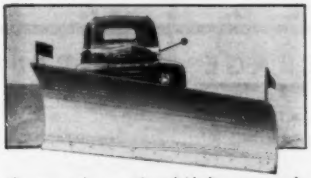

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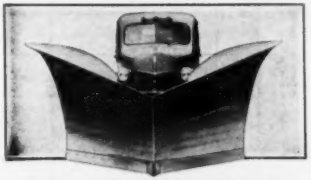

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PUBLIC WORKS DIGESTS

THE SEWERAGE AND REFUSE DIGEST

Chemical Oxidation Of Phenols in Wastes

The Ohio River Valley Water Sanitation Com'n has recently reported the results of studies conducted by Armco, Wallace & Tiernan, Ozone Processes Div. and Mathieson Chem. Corp. on oxidation of coke-plant waste. Significant findings for ammonia-still wastes were: Each oxidant (chlorine, ozone and chlorine dioxide) materially reduced BOD. Chlorine treatment requires pH adjustment to the 7-10 range, the others work best at 11.5. In chlorination, temperatures above 45 C may necessitate heavier dosage; ammonia demand must first be met (not necessary with the others); and oxidation must be complete if chlorophenols are to be avoided. Residual chlorine must be several hundred ppm to remove phenol or reduce it to low concentration; excess chlorine can be removed by activated carbon.

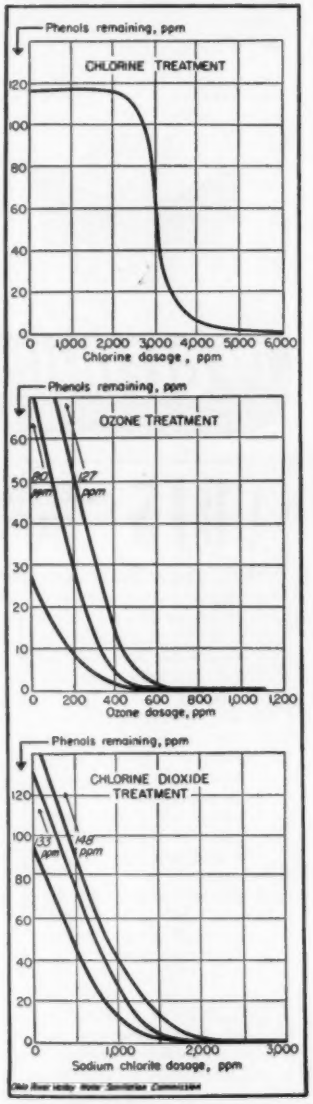
Residual ozone or chlorine dioxide can be controlled to within less than 1 ppm. Chlorine adds chlorides to the waste in an amount equal to the dose; chlorine dioxide adds about 1.5% chlorides, ozone adds none. The use of chlorine and chlorine dioxide together cut down the amount of chlorine dioxide needed.

"Phenols in Industrial Wastes Can be Destroyed Chemically;" *Engineering News-Record*, Aug. 16.

Quantity of Activated Sludge

The authors conducted experiments to learn the amount of excess activated sludge produced under various operating conditions and with varying sewage characteristics. They found that the sludge accumulated decreased with increasing mixed liquor suspended solids, when a given sewage was fed. With given mixed liquor suspended solids concentrations, the amount of sludge accumulated varied with different sewages. When the sludge accumulation was expressed on the basis of a unit amount of suspended solids fed, the variations between different sewages decreased somewhat. Sludge accumulation in these experiments varied from a minimum of 304 to a maximum of 1268 lb. per m.g. of sewage treated, depending upon the mixed liquor suspended solids and sewage strength. The sludge accumulation may be evaluated by the formula $A = 0.055\ S + 0.5\ B$; in which A is the lb. of volatile suspended solids accumulation per day; S is the lb. of volatile mixed liquor suspended solids; and B is the lb. of BOD fed per day; the temperature being approx. 20° C.

H. Heukelekian, H. E. Orford and R. Manganelli—"Factors Affecting the Quantity of Sludge Production in the Activated Sludge Process;" *Sewage and Industrial Wastes*, August.



Courtesy Engrg. News-Record

● ***PHENOL oxidation curve.***

Automatic Electric Lift Stations

Wet-well stations with submersible pumps are economical to construct, but they involve hazards of explosion and lethal gases, and extra and excessive maintenance. The hazards can be reduced by use of explosion-proof wiring, motors and fixtures, and forced-ventilation of wet well and structure over it. With a dry-pit installation, the wet well can be completely separated from the equipment and the room, and maintenance and operation are more convenient. For shut-off valves on each side of the pump, lubricated plug valves are much more satisfactory than gate valves. The pneumatic ejector is one of the oldest and most successful types of lifting equipment on the market, but is limited to lifts of 50 ft. or less, and can not compete with centrifugal pumps for more than 500 gpm because of its operating inefficiency; it also is noisy. In general, the most troublesome pumps are those less than 6" in size. For very small stations, where conventional trash pumps would be too small for reasonably reliable service, the "Flush Kleen" pump can be obtained in capacities from 50 gpm up, and the

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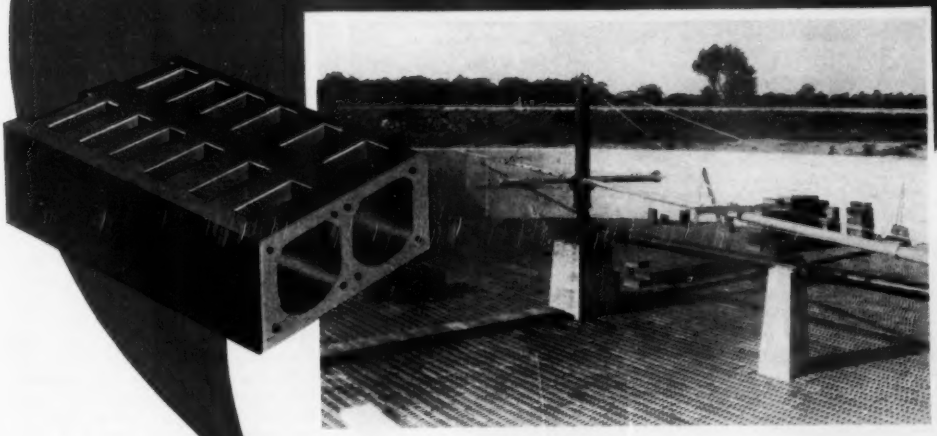

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"The Use of Copper Sulphate in Control of Microscopic Organisms" by Dr. Frank E. Hale (former Director of Laboratories, Dept. of Water Supply, City of New York) is an authoritative work concerning the control of micro-organisms and elimination of tastes and odors. Describes in detail methods of controlling various forms of microscopic life commonly encountered in water supply systems. Contains descriptive material, plus 48 photo-micrograph studies of organisms discussed.

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"Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," by John W. Hood, contains information published for the first time. This material includes actual methods for control and operating procedure. Here's the book that is a "must" for all sewage men.

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bladeless impeller pump from 30 gpm up. There should be at least two pumps; 3 or even 4 or 5 may be justified economically, depending upon several factors, which the author discusses.

Glenn E. Hands—"The Fundamentals of Sewage Pumping;" *Sewage and Industrial Wastes,* August.

Vacuum Filter Cloths

Comparison was made of filter cloths made of napped cotton twill, vinyon, napped wool, wool flannel, glass, nylon, silk, and cotton twill, based upon the percentage filtered in 5 min., turbidity of filtrate, moisture in cake, and sludge uptake (amount of sludge held in the cloth). These several characteristics and the cost per pound were weighted for comparison, giving cost a factor of 10, cake production a factor of 5, moisture in cake 3, cake discharge 2, and each of the others a factor of 1. On this basis, napped cotton twill is best, plain wool second, cotton twill third, napped wool fourth, and nylon last. If cost be omitted in the comparison, wool flannel is first, vinyon second, and napped cotton twill and glass tie for third and fourth places, with nylon last.

Arnold B. Joseph—"Comparative Study of Vacuum Filter Cloths;" *Sewage and Industrial Wastes,* August.

Sugar Cane Process Wastes

An efficient sugar mill utilizes and conserves almost all the sugar, byproducts and waste water, resulting in minimum pollution of surface waters. An investigation of sugar mills in Colombia, South America, showed waste effluents containing BOD varying from 140 to 1120 ppm. These should be used for irrigating the cane fields. The cachaza (floating matter skimmed from the squeezed sap) has a BOD of about 85,000 ppm, and by filtering this it is possible to reclaim sugar and fertilizer. The molasses has a BOD of more than 900,000 ppm and should be used for cattle feed or production of alcohol. The squeezed cane stalks can be used for fuel and the ashes for fertilizer.

Ralph Stone—"Sugar Cane Process Wastes;" *Sewage and Industrial Wastes,* August.

Fish as Indicators Of Toxicity of Waste Waters

Many industries along the seaboard discharge into the sea wastes which may have a toxic effect on marine life. These should be rendered harmless by dilution before discharge, and it is desirable to determine safe toxic levels of such effluents by a test that is inexpensive, easily operated and quickly made. The author recommends the use of fish for this purpose, especially Lagodon rhomboides which is distributed abundantly from Cape Hatteras to Mexico, is easily caught, and occupies a position of low to median tolerance to toxic materials. Using 7 or 8 large aquaria with 8 or 10 fish in each, and effluents in them diluted to different degrees respectively, the least diluted effluent in which no fish die during a 24-hour period indicates the tolerance limit.

F. M. Daugherty, Jr.—"A Proposed Toxicity Test for Industrial Wastes to Be Discharged to Marine Waters;" *Sewage and Industrial Wastes,* August.

One Year of Daytona Beach Process

The Daytona Beach process is high-rate chemical precipitation combining coagulation and settling in a single upflow tank, using as coagulant calcium carbonate sludge from the local water softening plant. (See *PUBLIC WORKS* for April 1949). It was in full operation by May 1950, and the record by months from that month to April 1951, both inclusive, are given. (In January 1951 no calcium carbonate was used because of changes being made at the water softening plant.) A 60% to 65% removal of BOD in the test run was required by the contract; the average for the year, omitting January, was 65.3%. The figure for January was 36.4%, showing the importance of the calcium carbonate to the process. The monthly averages ranged from 72.8%, with a flow of 2.8 mgd to 57.1 with a flow of 4.2 mgd.

"How the Daytona Beach Process Shapes Up Over Long Run:" *Engineering News-Record,* Aug. 23.

pH in the Activated Sludge Process

From experiments conducted at Baltimore's Back River sewage treatment works, it was concluded that the best performance, as judged by the oxygen consumed test, was at a pH of 7.0 to 7.5; but removals were almost as good beween 6.0 and 9.0. Removals averaged approximately 43% at a pH of 4, and 54% at a pH of 10.0. At a pH of 5.0-5.5, removals were much less than at 7.0-7.5 at first, but within a week were only slightly less. The removal of

suspended solids was greatest at a pH between 6.0 and 9.0, with the optimum between 7.0 and 7.5. Reduction of total bacteria was greatest at pH values between 6.0 and 9.0. Raising or lowering the pH on either side of neutrality greatly reduced the sludge index.

C. E. Keefer and Joseph Meisel—"Effects of pH of Sewage on the Activated Sludge Process;" *Sewage and Industrial Wastes*, August.

Treating Wastes From Rendering Plants

Wastes from plants that render inedible poultry, fish and animal offal and waste are chiefly strong liquids from the washing of trucks, barrels and floors. They are generally in a state of partial decomposition and are black, smelly and septic. For treating them, chemical coagulation seems best to meet the requirements of low capital investment, minimum mechanical equipment, economy and simplicity of operation, and evidence of results. In tests conducted, filter alum and chlorine were used; the former reacts with the bicarbonate alkalinity to form floc, and the CO_2 produced reduces the pH; the chlorine oxidizes the reduced material and coagulates the protein. These chemicals, if used in sufficient quantities, appreciably reduced the BOD and color. The doses used were 120 to 700 ppm of alum and 120 to 240 ppm of chlorine. These reduced the BOD from 1500-3800 ppm to 400-600 ppm. To reduce it much lower would necessitate much higher dosages.

Marvin L. Granstrom—"Rendering Plant Waste Treatment Studies;" *Sewage and Industrial Wastes*, August.

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Unfinished Sewers Earn an Income as District Builds Treatment Plant. Aug. 30, Pp. 28-31.

Properly Proportioned Sumps Essential to Pump Efficiency. By *R. H. Bird*, Peerless Pump Div. Aug. 30, P. 32.

Municipal Engineering (England)

New Type Pump to Handle Thickened Sewage. Aug. 10, P. 66.

Methods of Composting. Aug. 24, P. 100.

Public Works

Sliding Curve Quickly Solves Partly-Full Pipe Problems. By *H. J. Miles*, Prof. of C. E., Texas A&M College. September, Pp. 48-49.

Refuse Collection and Disposal Costs and Methods. By *C. E. Perkins*. September, Pp. 54-55.

Railroad Industrial Waste Treatment Plant. By *Rodney Coltart*, San Engr., Link-Belt Co. September, Pp. 57-58.

Sewage and Industrial Wastes

Factors Affecting the Quantity of Sludge Production in the Activated Sludge Process. By *H. Heukelekian, H. E. Orford* and *R. Manganelli*, N. J. Agri. Experiment Sta. August, Pp. 945-958.

Fundamentals of Sewage Pumping. By *Glenn E. Hands*, Cons. Engr. August, Pp. 959-967.

Determination of Chlorine Demands and Chlorine Residuals in Sewage. By *Isadore Nusbaum* and *Lawrence A. Myerson*, Chemist, Sew. Treat. Plant, Detroit, Mich. August, Pp. 968-976.

Effect of pH of Sewage on the Activated Sludge Process. By *C. E. Keefer*, Engr., and *Joseph Meisel*, Chemist, Bur. of Sewers, Baltimore, Md. August, Pp. 982-991.

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Rendering Plant Waste Treatment Studies. By *Marvin L. Granstran*, Ass't. Prof. of San. Eng., Univ. of N. C. August, Pp. 1012-1016.

Treatment of Pharmaceutical Wastes. By *James M. Brown*, San. Engr., Am. Cyanamid Co. August, Pp. 1017-1024.

Sugar Cane Process Wastes. By *Ralph Stone*, San. Eng. August, Pp. 1025-1028.

A Proposed Toxicity Test for Industrial Wastes to be Discharged to Marine Waters. By *F. M. Daugherty*, Jr. Marine Biologist, Tex. Game, Fish & Oyster Com'n. August, Pp. 1029-1031.

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Wastes Engineering

Removing Oils, Tars, Alkalis from Refinery Wastes. By *Fred G. Fellows*, Cons. Engr. September, Pp. 468-470.

Keeping Corpus Christi Dry. September, Pp. 471-473.

Operation and Care of Starters on Treatment Plant Motors. By *F. A. Kuhl*, Supt. Breese, Ill. September, Pp. 473-474.

How Sewage Treatment Needs of Terre Haute, Ind., Were Analyzed. September, Pp. 474, 478.

Variable Rate of Sewage Pumping at Stratford, Conn. *By Bowe, Albertson and Associates*. September, Pp. 475-476.

Low-Pressure Air Power in Sewage Aeration. By *Eric Quartly*, Plant Supt., San Diego Sew. Treat Works. Septmber, Pp. 477-478.

Activated Sludge

(*Continued from page 74*)

second are necessary to prevent deposition of solids. This circulation is developed when air supply is about 3 cfm per lineal foot of tank. At Ft. McClellan, nine months average data showed removals from the primary settled sewage to be 66.3 per cent for BOD and 77.8 per cent for suspended solids. Without pre-aeration the removals are approximately 30 per cent.

TABLE 1—Operating Data

Design flow	**5.0 Mgd.**
Minimum monthly flow	**2.54 "**
Maximum monthly flow	**7.09 "**
Average flow	**4.9 "**
Cu. ft air per gal.	**1.19**
Av. SS in aeration tank	**1250 Ppm.**
Av. BOD raw sewage	**197 "**
Av. BOD final	**18 "**
Av. removal	**91.2%**

The data in Table I, covering a 7-month period, give the performance of an activated sludge plant in a military installation when the aeration equipment was installed incorporating the above described features.

Radioactivity Gauge for Snowfall

A gauge using a radiation source to measure the water content of snowfall has been reported by the AEC. The device is used by the Weather Bureau in California where accurate measurement of the water content of the snow-pack on mountain slopes is a key factor in efficient use of this stored water for industrial, agricultural, and other purposes.

Previously, calculations of water stored in snow depended upon measuring the depth of the snow-pack and estimating water content by the density of cores cut through to the earth's surface and then weighed. This laborious method was complicated by the fact that many watersheds were inaccessible during the winter.

In the new gauge, a quantity of gamma-emitting radiocobalt is placed in a lead tube and, before the first snow falls, the tube is sunk in the ground until the upper end is flush with the surface. A radiation detector is mounted above the mouth of the tube so that gamma rays from the radiocobalt strike it after passing through the snow-pack. The snow absorbs and reduces the intensity of radiation in direct proportion to the water content. An automatic radio transmits the signal picked up by the detector.

The gauge has proved 95 percent accurate with snow-packs up to those equivalent to 45 inches of water—a higher degree of accuracy than is attainable conventionally.

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Life of Sludge Scrapers and Conveyors

There are 5½ miles of heavy duty chain and 1,500 sludge scraper flights in the Minneapolis-St. Paul sewage treatment plant. The plant is now in its twelfth year of service and some flight replacement has been necessary; however, only six flights had to be replaced in 1950. The main collectors still have the original chain, but some of this has been turned, and new drive sprockets and chain were necessary in the west pass of Tank No. 6. Many sprockets have been built up to compensate for wear.

Activated Sludge

(*Continued from page* 81)

able significance since it implies that instantaneous measurements of the OR potentials will give quantitative indications of the condition of the sludge in an activated sludge plant. This will permit the operator to make necessary adjustments before the sludge has actually deteriorated. A high reading of the ORP indicates that strong oxidizing conditions exist, while a low or negative ORP reading indicates that reducing conditions are predominating. It has been demonstrated that a low ORP reading can be obtained where the sludge still looks fairly good, but may in a matter of a few hours deteriorate or bulk. In other words, an instantaneous recording of the ORP, as on a chart, would indicate to the operator whether oxidizing conditions are being maintained or whether reducing conditions are tending to predominate. If the ORP reading tends to stay high the air supply and the dissolved oxygen should be adequate. If, for a period of time, he notes that the ORP has been dropping, he should immediately increase the supply of air and perhaps also the rate of sludge return. When the ORP is dropping it indicates that there is not enough oxygen or organisms present to oxidize properly the organic matter being supplied.

Hood has already used the ORP for controlling automatically the operation of an activated sludge pilot plant. It is hoped that in the very near future such control can be adapted to full-scale plants.

Research work at Ridgewood, New Jersey by Hood and Eckenfelder indicated that there is remarkable correlation at any given sewage plant between the BOD and the light transmission of a sewage sam-

ple. The light transmission reading is taken with a photoelectric cell and a transmission of 100 would be distilled water. Apparently, there is a straight line relationship which can be used at any given plant, after the calibration is made, for determining BOD within perhaps 10% to 15% of the actual value by an instantaneous measure of the light transmission by means of a photoelectric instrument. Such measurements are of inestimable value in any research study, or if it is desired to obtain information about a full-scale plant immediately, without having to wait five days for the BOD value. If extraneous inert material comes in with the sewage due to rains, the calibration will not be correct; but if the colloidal and suspended matter are practically entirely organic a good correlation of the light transmission factor and the BOD is possible. This is anther quantitative measurement which can be a very useful tool in the control of any sewage treatment plant and particularly the control of the activated sludge process.

Since one of the important quantitative measures for maintaining proper control of the activated sludge process is the suspended solids in the mixed liquor, it would be very convenient if this measurement could also be made without the need for filtering, drying, and using expensive gravimetric balances.

It has been shown that the centrifuge can be used very conveniently for the measurement of the suspended solids. A calibration curve can be developed so that the reading of the solids in the bottom of the tube after a certain time in the centrifuge is definitely related to the suspended solids in the liquor. This is another instrument which permits quick determination of a very important variable in an activated sludge plant on which proper control of the plant depends.

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Correction: Solution of Sliding Curve

A quick method of solving partly full pipe problems was presented on pages 48 and 49 of the September issue. The dashed lines marked "V" and "$V^2/2g$" referred to under the heading "Other Uses," were inadvertently omitted in redrawing Fig. 1 for publication. However, the text indicates the method of constructing these lines. The "V" line is obtained by connecting several points where velocity lines intersect numerically equal discharge lines, as where $V = 1$ intersects $Q = 1$. The "$V^2/2g$" line is the locus of points where $Q = 10$ $V^2/2g$, that is it is formed by connecting several points where velocity lines intersect lines representing values of discharge numerically ten times as great as the corresponding velocity heads.

We are sorry for these omissions, but believe that our readers can construct them on their own charts by following Prof. Miles' clear and explicit directions in the text of the article in our September issue.

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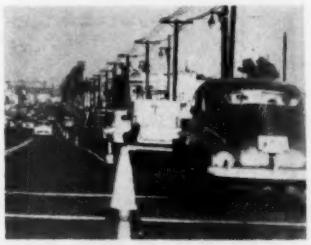
The Trafficone system of traffic control consists of the Barricade Trafficone standing 40 ins. high with adapter sign, or 28 ins. without, and weighing 6½ lbs.; and the Channel Trafficone standing 18 ins. high and weighing 2½ lbs. While these Trafficones have the appearance of steel, they are of safe, flexible rubber. The ability to set up traffic barriers and lane channeling in a tenth of the time required with wood or wire markers, the minimum storage and transportation space required, and the durability has saved much money in traffic control. The City Traffic Engineer of Los An-



Trafficones guide traffic

geles claims that it would have cost $150,000 to duplicate traffic control by auxiliary highways if these cones had not been available. Full information from Interstate Rubber Products Corp., 908 Avila St., Los Angeles, Calif., or by using the coupon.

Use coupon on page 131; circle No. 10-4

Versatile Shoveloader for Case Tractor

Built especially for the Case VAI tractor, this 3-B shoveloader permits the installation of the Case VAI-5 mower attachment without interfering with the operation either

Mower and Shoveloader

The original primary Spiraflo Clarifier, installed at Flora, Illinois in 1937, now averages better than 50% B.O.D. removal when operating in excess of 1000 gallons of surface rate and 1½ hours of detention. The final tank is also a Spiraflo.

Spiraflos, when operating on domestic sewage, are averaging from 45 to 55% B.O.D. and from 70 to 80% S.S. removal.

High primary clarifier removals of B.O.D. and S.S. result in better plant effluents. When used with Aerofilters, the overall plant removal of B.O.D. runs from 85 to 90% and in two-stage plants from 90 to 95% without parallel recirculation.

There are now over 100 Spiraflos in operation or under construction.

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of the shovel or of the mower. They operate independently and neither need be removed while the tractor is operating the other. Quickly interchangeable loader attachments permit the use of ⅜, ½ and ¾-yd. buckets, bulldozer, lifting crane, For more data write Lull Mfg. Co., 3612 East 44th St., Minneapolis 6, Minn., or use the coupon.

Use coupon on page 131; circle No. 10-5

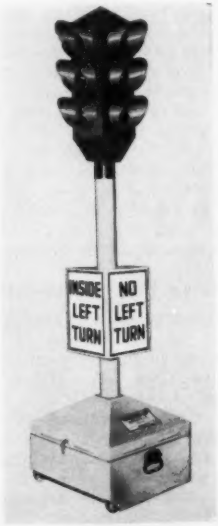
Chlorinator Cleaner

This chlorinator cleaner will quickly and easily remove chlorine hydrate, gum, wax and similar accumulations from bell jars, floats, trays, needle valves, metering tubes and gas delivery tubes. It is safe and will not injure any parts of any chlorinator. A descriptive circular is available from Lake Products Co., Inc., 6576 Oleatha Ave., St. Louis 9, Mo., or by using the coupon.

Use coupon on page 131; circle No. 10-6

Portable Traffic Control Signal

The "Mechanical Cop" is a self-contained portable traffic control signal especially suited for controlling peak traffic loads. The cost is substantially below the cost of permanent installations. The signal stands 8 ft. high and weighs 290 pounds. It operates either on 110 volts or on a battery housed in the base which provides enough power for 30 hours of continuous opera-



"A good cop."

tion without recharge. It can be moved easily on supporting rubber casters. Special signs, as shown in the illustration can be attached. Full information and prices from Henderize, Inc., 5667 Freeport Blvd., Sacramento, Calif., or use the coupon.

Use coupon on page 131; circle No. 10-7

All-Electronic Portable Signal Flasher

Available for immediate delivery, this new flasher of cold cathode tube design emits a sharp, brilliant flash of light. It is unaffected by vibration, humidity or temperature. It has no moving parts or filaments, assuring longer battery life and long range visibility. It weighs only 8½ lbs. A clear or colored Fresnel lens protects the life-time cold cathode tube. It is furnished complete with batteries. More data from Haledy Electronics Co., 57 Williams St., New York 5, N. Y., or by using the coupon.

No bulb, no flame.

Use coupon on page 131; circle No. 10-8

Dynel Fabrics for Vacuum Filtration

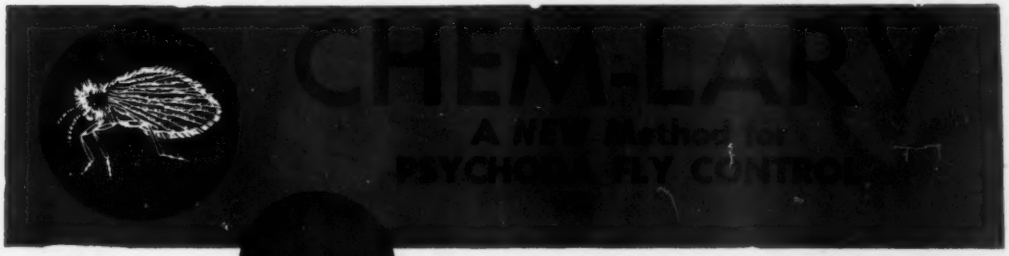
Two dynel filter fabrics, a twill weave and a broken chain weave, are said to give a higher flow than previously available nylon, dynel, Orlon or Vinyon-N fabrics. These dynel fabrics offer a wider range of chemical resistance than any other of the Feon synthetics. Dynel being a spun-staple fiber from Vinyon-N, a copolymer of vinyl chloride and acrylonitrile, is virtually unaffected by most concentrated mineral acids and resists a wide range of organic acids, bases and salts, and can be used at temperatures to 250°F. These cloths are available as yard goods or tailored to fit any type of pressure or vacuum filter, centrifuge or dry filtration equipment. Full data from Filtration Engineers, Inc., 155 Oraton St., Newark 4, N. J., or by using the coupon.

Use coupon on page 131; circle No. 10-9

Derrick-Digger Attachment for Small Trucks

This equipment is especially designed for digging holes and setting poles. It can be attached to any ¾-ton or 1-ton truck with ordinary service body. It takes two men less than ten minutes to set up the derrick, attach the hole digger, dig the hole and set the pole ready for tamping. Augers are interchangeable, 8 ins. to 20 ins. As a material handler, this unit will pick up poles and heavy equipment. It is fine for

Derrick and digger.



TESTS at the Village of Ridgewood, N. J. and City of Worcester, Mass. filter beds indicate that the residual properties of CHEM-LARV suppresses the numerical growth of psychoda flies beyond the ability of other agents tried.

Use the coupon below to receive a copy of the Technical Bulletin "CHEM-LARV for PSYCHODA FLY CONTROL" and How It May be Adapted for Your Particular Requirements.

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guard rail setting. More data from Tel-E-Lect Products Inc., 10001 Minnetonka Blvd., Minneapolis 16, Minn., or by using the coupon.

Use coupon on page 131; circle No. 10-10

Handy-Sized Truck Mixers

Featuring a visible mixing action, the HI-LO and HI-LO Jr. truck mixers can carry up to 3 cu. yds. of mixed concrete and not exceed the normal single-axle highway weight limitation of 18,000 pounds. Mixers can be installed on any chasses, and these can be furnished by the customer or the factory. Operation is by power take-off or by separate engine as desired. For illustrated bulletin write Concrete Transport Mixer Co., 4974 Fyler Ave., St. Louis 9, Mo., or use the coupon.

Use coupon on page 131; circle No. 10-11

Carries ready-mix.

Two New Portable Gravel Plants by Pioneer

Two portable duplex gravel plants have been announced. These, the 24V and the 25V, are identical except that the former has a 10x24 jaw crusher and the latter a 10x36. Both have 24x16 double roll crusher, with vibrating screen and a 25-ft. conveyor. Both plants ride on 12 pneumatic tires, so designed as to meet restricted road load limits. Full data from Pioneer Engineering Works, 1515 Central Ave., Minneapolis 13, Minn., or by using the coupon.

Use coupon on page 131; circle No. 10-12

Earth Anchor Useful for Many Jobs

For anchoring guy lines, making dead-man installations and providing piling and piering for various types of construction, this earth anchor will be found economical and useful. It consists of a pointed steel body with a wide-flange screw which pulls itself into and positively locks itself in the earth. It takes 3 to 5 minutes to install one; backing out takes 2 minutes; and the anchors may be reused. Full dope on sizes, installation details and combinations from Van Dyke In-

Skyhook in reverse.

MUD-JACK* cuts costs on slab repairs and maintenance

MUD-JACKING is an easy, low-cost method of raising concrete slabs and stabilizing sub-grade support on sidewalks, driveways, sectional curb and gutter alignments, man-hole repairs. Application is simple. Koehring Mud-Jack pumps inexpensive soil-cement slurry into small holes drilled through depressed slab. Result — you get firm, lasting sub-grade fast and easy, with no inconvenience to public. No. 10 Koehring Mud-Jack, illustrated, is particularly suited to city maintenance because it's a small, self-contained unit . . . no traffic detours necessary. Portable as a wheelbarrow on the job . . . quickly moved job to job. Big, No. 50 Mud-Jack also available for extensive highway work. Get complete Mud-Jack facts from your Koehring Distributor today.

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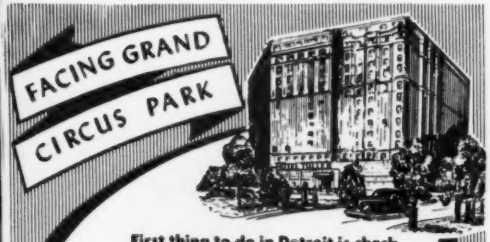

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dustries, 3625 Cahuenga Blvd., Los Angeles 28, Calif., or by using the coupon.

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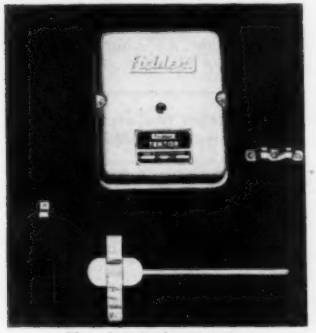
Without reliance on electrical contact with the material under control, or on floats, diaphrams or



No electrical contacts.

any moving mechanical parts, this level control maintains a level differential of 1/32 in. up to ⅜ in. Liquids may have high or low viscosity, or may have electrical conducting or insulating properties. The electrode consists of a simple probe, which may or may not be insulated, 4 ins. to 6 ins. long, which is inserted at the level at which control is required. Available immediately from Fielden Instrument Corp., 2920 North Fourth St., Philadelphia 33, Pa., or by using the coupon.

Use coupon on page 131; circle No. 10-14

Low-Cost Kitchen-Bath Plumbing Unit

D. S. Abell,

Institute of Inter-American Affairs, Montevideo, Uruguay

EVERY family in Uruguay, it seems, has a radio; but relatively few have running water in the home. To utilize normal plumbing products, the cost of a plumbing installation ranges around 1,000 pesos or about $500. To find lower cost, locally made fixtures has been a project to which we have devoted much energy in order that inside-the-house plumbing could be made available to the maximum number of homes.

There has been developed locally a kitchen-bath unit of concrete, designed for very low-cost homes.

FOSTER FLOW TUBE

Gentile Patents

FIVE FEATURES

for your Consideration:

1 . . . **Compactness** Note in the picture above the short axial length. Tubes 3" in size and larger are approximately 1 to 1½ diameters long, depending upon the velocity in the main. For high main line velocities (above 10 ft/sec. for liquids) tubes are less than 1 diameter in length.

2 . . . **Ease of Installation** Due to its compactness and because it requires no straight runs upstream or downstream, except near valves or regulators, the total space required for installation is but a small fraction of that necessary for other primary devices. It can be installed as readily as a fitting and in that section of the line most conducive to steady flow conditions. Moreover, it can be installed in the plant proper, eliminating the need for expensive vaults or housing.

3 . . . **Reversibility** The Foster Flow Tube is symmetrical transversely; upstream and downstream nozzles and ports are identical. This means that where processing calls for flow reversal, the meter can readily handle the changes.

4 . . . **Low Head Loss** Where head losses are important Foster Flow Tubes are designed with a main-to-throat ratio that provides negligible unrecovered head losses.

5 . . . **Accuracy** All Foster Flow Tubes are furnished with calibration curves obtained in laboratory tests simulating installation conditions and can therefore be guaranteed to an accuracy to meet any specification.

Foster Flow Tubes are recommended for a wide range of services metering the flow of liquids and wet or dry gases. They are available in all commercial pipe sizes with flanged or screwed connections. Standard lining is bronze but other materials are available. In writing for further information, give processing and installation details of your metering requirements.

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Low-cost kitchen, bath and toilet used in Uruguay.

There is one essential with this, there must be a common wall between the kitchen and the bathroom, In this wall is inserted the wall section, into which are precast on the kitchen side, a wash tub and kitchen sink; and on the bathroom side a lavatory, with necessary piping. A squat-type toilet is an integral part of the floor section which extends out as a part of the bathroom floor beneath the shower head.

Thus, the shower water drains into the toilet which is made with a trap or siphon below. This is the only trap in the house, and through it all waste water discharges; or the toilet can be flushed by filling any one of the units.

This precast unit is manufactured and delivered anywhere in Uruguay for less than 100 pesos, or $50. It is estimated that the total installation, with water and sewer connections will amount to 300 to 400 pesos. In Uruguay, privies constructed of brick or stone cost nearly as much as the indoor unit cost.

This unit, involving a new use for materials, meets no plumbing code the writer has ever seen. It does, however, appear to afford protection to public health. Though the unit is patented, the developer—Compania Uruguya de Productos de Hormigon, Rocco, S.A., of Montevideo—wishes to encourage the development and wide use of the idea, with minimum profit and maximum benefit to health.

PERSONAL NEWS

Chester T. Butterfield, top bacteriologist of the Cincinnati Public Health Service Center for the past 36 years, and Director of Research for the past two years, retired as of Aug. 31.

G. R. Fitterer has been appointed Dean of the Schools of Engineering and Mines at the University of Pittsburgh. A graduate of Rose Polytechnic, he has been professor and head of the metallurgical department since 1939.

Harry R. Hall, for many years outstanding in sanitary engineering, has retired. Since 1936, he has been chief engineer of the Washington Suburban Sanitary District; and for 18 years prior to that time was deputy chief engineer. He was graduated from MIT in 1907, coming to the District after service with the Massachusetts and Maryland Departments of Health.

Ohio Street Maintenance & Sanitation Officials

The Fall meeting of the Street Maintenance and Sanitation Officials of Ohio will be held in Youngstown, O., at the Hotel Pick-Ohio, Oct. 18 and 19. Robert E. Willems, 604 Municipal Building, Akron 8, Ohio, is president.

Commissions for Engineers

Commissions as airport engineering officers, in grades from 1st Lt. to Lt. Col., are being granted by the Air Force to men with a degree of civil engineering, plus active

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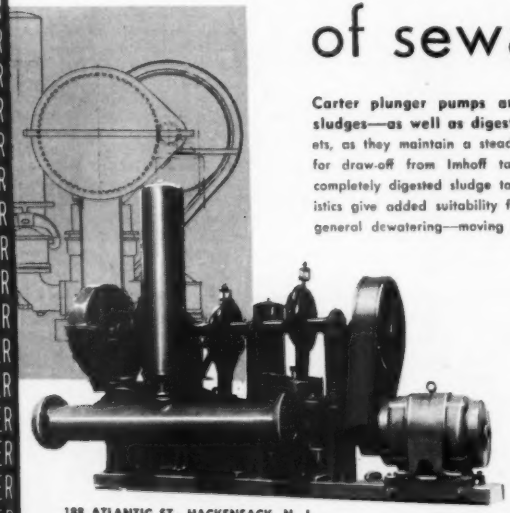
for efficient pumping of sewage sludges...



Carter plunger pumps are ideal for pumping primary and secondary settled sludges—as well as digested sludges—with a minimum of disturbance in sludge blankets, as they maintain a steady rate of removal, without pulling holes in sludge layers . . . for draw-off from Imhoff tanks . . . with ferric chloride feeders attached, for moving completely digested sludge to vacuum filters for final drying. Exxcellent suction lift characteristics give added suitability for the many pumping jobs around a sewage treatment plant, general dewatering—moving sewage, manhole cleaning, tank cleaning, etc.

The complete line of Carter plunger sludge pumps comprises three basic models: Balto — Standard and Heavy-Duty. The Balto and Standard types are available in single, double and triple plunger designs—known as the Simplex, Duplex and Triplex. The Heavy-Duty type is available in duplex, triplex and quadruplex models. Further selectivity for specific applications is offered with four piston diameters—and the exclusive 14-stroke overhead variable eccentric drive in Balto and Standard types. The Heavy-Duty type offers two piston diameters—and featrues a set-stroke eccentric drive, with capacity variations provided by multi-speed drive.

188 ATLANTIC ST., HACKENSACK, N. J.

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Bulletin 5102—the latest revision on our sludge pump data—is now off the press. Write for your free copy today!

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technical experience in airport and highway work. Further information from Military Personnel Procurement, First Air Force, Mitchell Air Force Base, N. Y.

City Supplies Garbage Cans

Hutchinson Kansas, supplies 10-gallon garbage cans to every home in residential areas, collects refuse twice a week, and washes the cans with special equipment every two weeks. A truck-mounted washer follows the city's regular collection equipment. Wash water contains a detergent and is heated by propane gas to a temperature of 180 degrees. —Public Management.

Velocity Constant Determination at Minneapolis-St. Paul

Investigational work was carried out at the Minneapolis-St. Paul sewage treatment plant by Walter E. Williams to determine the relation between the pH and the velocity constant, k. With plant effluent buffered to 6.5, 7.2 and 8.0 pH, BOD curves were practically identical. The velocity constant "k" of each of these curves was about 0.17, as computed by the Thomas method.

Water and Sewage CHEMISTRY and CHEMICALS

A Valuable Reference

In the operation of modern water and sewage treatment plants, some knowledge of chemistry and chemicals is essential. This practical text is now available in handy reprint form. All the information in this valuable handbook is presented in simple and not-too-technical terms so that anyone can understand it.

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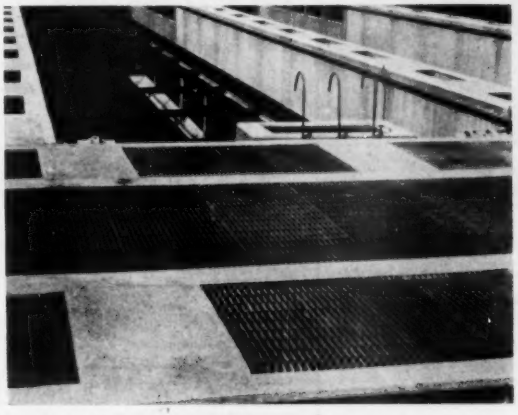

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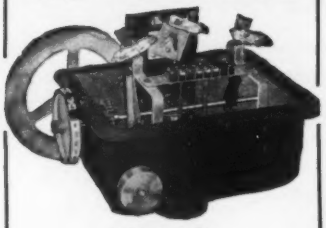

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with ALTO-TROL

Puts that second pump to work.

A 2-pump RF-2 ROTO-TROL with a built-in ALTO-TROL will operate each pump on alternate starting cycles, assuring equal use and wear of both pumps. Operates both pumps when required.

Depth Indicator optional—extra.

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INDEX OF ADVERTISEMENTS

Alabama Pipe Co. 88
Albright & Friel, Inc. 120
Allis-Chalmers 31
Alvord, Burdick & Howson 120
Armco Drainage & Metal Prod. 18
Atlas Mineral Products Co. 130
Austin-Western Co. 27
Ayer-McCarel-Reagan Clay Co. ..... 34, 35 & 115

Baker, Jr., Michael 120
Bannister Engineering Co. 120
Barker & Wheeler 120
Black & Veatch 120
Bogert Assoc., Clinton L. 120
Bowe, Albertson Assoc. 120
Bowerston Shale Co. ..... 34 & 35
Briggs & Stratton Corp. 26
Brown & Brown, Inc. 138
Brown, Francis L. 120
Brown, Engineering Co. 120
Buck, Seifert & Jost 120
Buffalo Meter Co. 103
Builders Providence, Inc. 100
Burgess & Nipple 120
Burns & McDonnell Eng. Co. 120
B/W Controller Corp. 88

Caird, James M. 120
Calgon, Inc. 32
Capitol Engineering Corp. 121
Carter Co., Ralph B. 128
Cast Iron Pipe Research Assn. ..... 8 & 9
Caterpillar Tractor Co. 15
Contrilinq Corp. 137
Champion Corp. 96
Chemical Insecticide Corp. 125
Chicago Pump Co. ..... 19 to 22
Chester Engineers 121
Clarke Gardner & Assoc. 121
Clark-Wilcox Company 48
Combustion Engrg.-Superheater, Inc. 50
Cole & Son, Chas. W. 121
Consoer, Townsend & Assoc. 121
Continental Steel Corp. 134
Conveyor Company 7
Corson, Oscar 121

Darley & Co., W. S. 124
DeLeuw, Cather & Co. 121
Dempster Brothers, Inc. 85
Dickey Clay Mfg. Co., W. S. ..... 34 & 35
Dixon Crucible Co., Joseph 136
Dorr Co. 29
Dow, A. W., Inc. 121
Dresser Industries, Inc.
(See Roots-Connersville Blower Corp.)
(See Dresser Mfg. Division)
Dresser Mfg. Div. 40

Eagle Crusher Co. 129
Eastern Gunite Co. 132

Fairbanks, Morse & Co. 101
Federal Enterprises, Inc. 45
Fisher Research Lab., Inc. 112
Fitch Recuperator Co. 96
Flexible Sewer-Rod Equipment Co. 48
Ford Motor Co. 23
Foster Engineering Co. 127
Frink Sno-Plows, Inc. 42

Galion Iron Works & Mfg. Co. 13
Gannett, Fleming, Corddry & Carpenter, Inc. 121
General American Trans Corp. 46
General Electric Co. ..... 10, 11 & 37
Gieseke, George 121
Gilbert Associates, Inc. 121
Gledhill Road Machinery Co. 113
Gorman-Rupp Co. 44
Government Employees Insurance Companies 118
Greeley & Hansen 121
Green Co., Howard R. 121

Hagan Corp. 32
Harte Co., John J. 121
Hasie & Green Engrg. Co. 121
Healy-Ruff Co. 130
Hellige, Inc. 136
Heltzel Steel Form & Iron Co. 30
Henry Mfg. Co., Inc. 111
Hill & Hill 121
Hitchcock & Estabrook 122
Holmes Co., Ernest 16
Homelite Corp. 24
Hotel Tuller 126
Hotpoint, Inc. 97
Hough Co., Frank G. 52
Huber Mfg. Co. 2
Hydraulic Development Corp. 124

Industrial Materials Co. ..... 34, 35 & 91
Inflico Inc. 12
Insto-Gas Corp. 90
International Harvester Co. 4
International Salt Co. ..... 38 & 39
Irving Subway Grating Co. 129

Jaeger Machine Co. 133
Jeffrey Mfg. Co. 33
Jones, Henry & Schoonmaker 122

Kennedy, Clyde C. Co., ... 122
Knowles, Inc., Morris 122
Koehring Co. 126
Komline-Sanderson Engineering Corp. 118

Layne & Bowler, Inc. 105
Lakeside Engineering Corp. 124
Lewis, Harold M. 122
Link Belt Co. 25
Littleford Bros., Inc. 36
Lock Joint Pipe Co. 139
Lozier & Co., Wm. S. 122

Metcalf & Eddy 122
M & H Valve & Fittings Co. 106
Municipal Service Co. 98

National Clay Pipe Mfrs., Inc. 95
National Fireproofing Corp. ..... 34, 35 & 93
National System Garage Ventilation 110
Nelsen Iron Works, Inc., N. P. 111
Nichols Engrg. & Research Corp. 44

Onan & Sons, D. W. 133
Oliver Corp. 41
Oliver United Filters 99

Pacific Flush Tank Co. 87
Palmer & Baker, Inc. 122
Permutit Co. 47
Pfeifer & Schultz 122
Phelps, Inc., Boyd E. 122
Phelps Dodge Refining Corp. 116
Pirnie Engineers, Malcolm 122
Pitometer Company 122
Pittsburgh-Des Moines Steel Co. 89
Pittsburgh Pipe Cleaner Co. 113
Pomona Terra-Cotta Co. ..... 34 & 35
Presure Concrete Co. 112
Proportioneers, Inc. 135
Public Works 129

Quinn Wire & Iron Works 112

Robert & Co. 121
Rock Island, Ill. 129
Roberts Filter Mfg. Co. 132
Roots-Connersville Blower Corp. 28
Rockwell Co., W. S. 92
Russell & Axon, Cons. Engrs. 122

Service Supply Corp. 109
Simplex Valve & Meter Co. 107
Skinner Co., M. B. 134
Smith & Gillespie 122
South Bend Foundry Co. 124
Stanley Engineering Co. 122
Stilson Assoc., Alden E. 122

Tarrant Mfg. Co. 113
Taylor, Henry W. 122
Texas Vitrified Pipe Co. ..... 34 & 35
Tilden Tool Mfg. Co. 110
Trackson Co. 14
Trickling Filter Floor Institute ..... 34 & 35

U-C Lite Mfg. Co. 136
Universal Concrete Pipe Co. 42
U. S. Pipe & Foundry Co. 119

Wallace & Tiernan Co., Inc. ..... Back Cover & 17 & 49
Wertz & Assoc., Emerson D. 122
Westinghouse Electric Corp. 94
Weston Co., L. A. 112
Wolverine Tube Division 3
Wood Co., R. D. 104
Worthington Pump & Machinery Corp. ..... 43 & 51

EQUIPMENT DATA TO HELP YOUR PUBLIC WORKS PROGRAM

The engineering information in these helpful catalogs will aid you in Engineering and Public Works programs. Just circle numbers you want on the coupon or write the manufacturer direct and mention PUBLIC WORKS.

Introducing Water Works Problems To the Public

222. To help water works men and other municipal officials demonstrate to their communities the urgent importance of proposed water works projects, the General Electric Company has prepared a 40-page manual "Good Water—and Plenty of It". Attractively arranged and forcefully presented, the manual provides a convenient summary of the arguments for comprehensive, long-range planning; shows how to interpret your proposal to the public and win community support; and suggests helpful public relations programs. A copy of this manual should be in every water works office. Yours can be had by checking the coupon or writing General Electric Co., Sect. 666-67, Schenectady, N. Y.

Be Sure to Investigate Two-Piece Filter Floor Construction

223. Advantages claimed for trickling filter floors constructed of IMCO Two-Unit blocks include: greater mechanical strength; maximum aeration efficiency; smooth flow line in drainage channels; and construction simplicity. Full information on this long-tested floor system is available from Industrial Materials Co., Somerset St. & Trenton Ave., Philadelphia 34, Pa., or by checking the handy coupon.

What Chemicals and Apparatus Does A Laboratory Need?

225. In two convenient check-off lists compiled by Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill., the chemicals and apparatus needed for nearly 100 tests used in water and sewage analysis are indicated. These lists are useful for all operators, designers and contractors. Just check the coupon for your copies.

Study of Water Hammer Presented in New Booklet

237. The cause, effect and control of water hammer in piping systems are considered in a new 8-page bulletin published by The Williams Gauge Company, Pittsburgh, Pa. After describing water hammer in non-technical terms, the brochure indicates its potential damage to piping, instruments and other parts of water systems, and then considers methods of controlling it. Check the coupon for your copy of this bulletin.

Snow Plows for Every Street and Highway Need

227. In a new bulletin, No. 51-F, full details are given on the Frink reversible trip-blade "Sno-Plow", which has special design features to eliminate chatter and to permit quick adjustment to nine plowing positions or scraping position for ice removal. Check the coupon for your copy. Frink Sno-Plows, Inc., Clayton, N. Y.

Sewage Screening and Cutting with the Griductor

233. How the Griductor operates, construction details, and dimension and capacity data are given in Bulletin 5100. Special features include double ended cutter teeth which are readily resharpened. For your copy, write to Infilco Inc., Box 5033, Tucson, Arizona or use the handy coupon.

Profitable Construction with Payloader

234. A comprehensive, 12-page catalog filled with on-the-job photos showing a wide variety of earth-moving, material-handling, lifting and carrying jobs being performed by the multi-purpose tractor-shovels known as "Payloaders" is now available. Helpful job data, specifications and features of the complete Payloader line are included, with illustrations of useful accessories. Copies of this colorful catalog No. 217 can be obtained from The Frank G. Hough Co., 761 Sunnyside Ave., Libertyville, Ill., or by checking the coupon.

Underdrains-Hidden But Important Filter Components

248. For filter bottoms this firm makes "Armcre" vitrified salt glazed floor blocks which provide ducts occupying 50% of the floor cross-section and air openings aggregating over 24% of the floor area. Described in several leaflets and data sheets. Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

Vacuum Filters Feature Fast, Non-Clog Operation

241. Get full data on vacuum filters using double layers of continuous coil springs that insure continuous, non-clog operation for sewage sludge dewatering. Coils are automatically cleaned at each revolution. Komline-Sanderson Engineering Corp., Peapack, N. J.

Automatic Lighting During Power Failure

221. "Big-Beam" emergency lights go on instantly when power fails. Compact, battery-operated floodlight units are available in several models, operate automatically when plugged into conventional lighting outlet. U-C Lite Mfg. Co., 1037 W. Hubbard St., Chicago 22, Ill. For details check the handy coupon.

Install Long-Lasting Tide Gates

247. Data on tide gates of all sizes, both circular and rectangular, are offered in bulletins available from Brown & Brown, Inc., Lima, Ohio. Check the coupon for your copies.

Free Aid To Better Arc Welds

246. A pocket size booklet "Hobart Welding Electrodes and Welders' Vest Pocket Guide," gives useful arc welding information, including essentials of proper welding procedures, types of joints, causes of common welding troubles and handy reference data. For your free copy check coupon. The Hobart Brothers Company, Troy, Ohio.

Book Tells How to Control Root Stoppages

249. Details on the proven use of copper sulfate to control root and fungous growths in sewers are contained in a brand-new book published by Phelps Dodge Refining Co., 40 Wall St., New York 5, N. Y.

Vacuum Filter Design Data

252. Typical flow diagrams, details of operation, power requirements and standard sizes of individual units and "package" units of the Oliver Sewage Sludge Dewaterer are presented in Bulletin 219. Check coupon for your copy. Oliver United Filters, Inc., 33 W. 42nd St., New York, N. Y.

Design Data for the Spiraflo Clarifier

254. Be sure to investigate the advantages of the Spiraflo clarifier for sewage treatment. Full engineering data, description of the unit, test results and specifications are offered in 24-page bulletin 122 by Lakeside Engineering Corp., 222 W. Adams St., Chicago, Ill. Check the coupon today.

Insurance Benefits For Civil Employees

256. Civilian government employees are offered insurance protection at the lowest possible cost by Government Employees Insurance Companies, Gov't Employees Insurance Bldg., Washington 5, D. C. Full details available by checking the coupon.

READER'S SERVICE DEPT. PUBLIC WORKS MAGAZINE 310 East 45th Street, New York 17, N. Y.

Please send me the following literature listed in the Reader's Service Dept. of your October issue.

Booklets from pages 132-137:

20	22	23	29	31	33	34	36	39	41	42	46	49	50	54	60	61	65	68
70	75	77	78	80	82	85	88	89	90	91	97	98	100	106	111	112	114	116
117	122	125	128	132	137	143	145	151	153	155	156	159	162	164	168	169	171	174
177	179	180	183	185	190	191	194	199	201	202	203	204	208	209	213	215	218	221
222	223	225	226	227	233	234	237	238	239	241	242	243	244	246	247	248	249	252
253	254	255	256	271	272	278	281											

New Products, pages 123-127:

10-1	10-2	10-3	10-4	10-5
10-6	10-7	10-8	10-9	10-10
10-11	10-12	10-13	10-14	-

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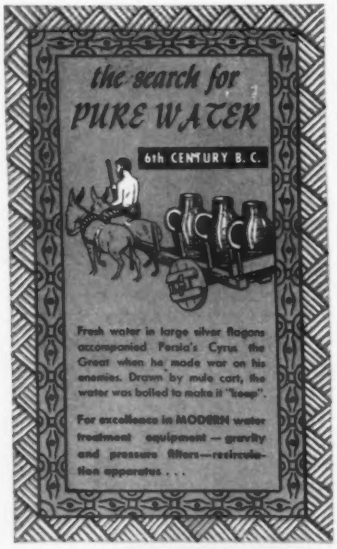
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SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay underdrain blocks conforming to ASTM standards, suggestions for layout and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute, % Editor, Public Works, 310 E. 45th St., New York 17, N. Y. Check the coupon and we will forward your request.

Something Different! "Pipe Dreams" Full of Fun and Good Sense

22. The Universal Concrete Pipe Company will be glad to send you regular issues of "Pipe Dreams", their delightful pocket-size magazine full of American philosophy and good cheer. No cost or obligation. Just write Universal Concrete Pipe Company, Dept. PW, 297 South High St., Columbus 15, Ohio.

Water Level Controls for Sewage and Water Plants

31. Dependable float-operated pump and motorized valve controls for single or multiple pump installations are described in bulletins issued by the Water Level Controls Div., Healy-Ruff Co., 719 Hampden Ave., St. Paul 4, Minn. All units feature splash proof construction, mercury tube switches.

Packaged Sewage Treatment— Just Right for Small Places

36. "Packaged" Sewage Treatment Plants specifically developed for small communities—100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

A Handbook of Sewer Cleaning Equipment and Methods

46. A new, fully illustrated 40-page booklet shows every sewer cleaning operation with "Flexible" tools. Includes data on the fast and easily operated new Sewe RodeR and full engineers' specifications for power bucket machines. For your copy write Flexible Sewer Rod Equipment Co., 9059 Venice Blvd., Los Angeles 34 Calif.

How You Can Dispose Of Sewage Solids

54. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 70 Pine St., New York 5, N. Y.

Improved Clarification with Carter Circular Collectors

61. Latest 16-page bulletin on water and sewage equipment, No. 4906, gives complete data and specifications on Carter's three different types of clarifiers. A valuable working guide for every sanitary engineer. Ralph B. Carter Sales, Inc., Dept. PW, 188 Atlantic Ave., Hackensack, N. J.

Check This Service When Building Water or Sewage Plants

65. Experienced engineers and craftsmen of Municipal Service Company can help you by furnishing and installing mechanical equipment and piping for water and sewage plants. Nation wide service is available. Get full information on your current jobs by writing Municipal Service Co., M-1, 908 Grand Ave., Kansas City, Mo., or use the coupon.

Odorless Sanitary Septic Tank Cleaning

88. The Gorman-Rupp Odorless Sanitary Cleaning unit combines centrifugal self-priming pump, air-cooled engine and oval tank on a sturdy frame. For full description of this adaptable unit get bulletin 7-ST-11. Gorman-Rupp Co., 120 N. Bowman Ave., Mansfield, Ohio.

Using Sewage Sludge Gas For Power Generation

90. Fairbanks-Morse dual fuel engines can operate on either sludge gas or oil to provide steady power output despite fluctuations in gas supply. Bulletins are available on several sizes to meet your needs. Write, giving exact requirements to Fairbanks, Morse & Co., Dept. PW, 600 So. Michigan Ave., Chicago 5, Ill., or use handy coupon.

How Cities Can Do Complete Sewer Cleaning From Street

98. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Power machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana

Useful Data on Butterfly Valves

100. Complete descriptions and tables of dimensions on the full line of Rockwell Butterfly Valves is contained in several bulletins published by the company. Construction details and special control features are illustrated. Write W. S. Rockwell Co., 200 Eliot Street, Fairfield, Conn.

Design Data for Trickling Filter Underdrains

116. A new 16-page bulletin gives full details on the use of Natco Unifilter blocks for trickling filter underdrains. Specifications, construction details and design data are included. Write Dept. PW, National Fireproofing Corp., 327 Fifth Ave., Pittsburgh 22, Pa., or use the coupon.

Need Low-Cost Air For Sewage Treatment?

122. New 20-page booklet shows operating and construction features of Rotary Positive Blowers engineered to fit your needs. Air for activated sludge, water treatment; constant vacuum for filtering. Bulletin 22-23-B-13 gives details. Roots-Connersville Blower Corp., 510 Poplar Ave., Connersville, Ind.

Engineering Data on Digester Heating

128. An excellent 32-page bulletin covering all features of the PFT External Heater and Heat Exchanger unit discusses effective digester heating, size of heater and exchanger, space requirements, building heating, and related items. Curves and tables provide full data for the designer. Check the coupon for your copy of this comprehensive bulletin, No. 235. Pacific Flush-Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

Fast and Easy to Handle Sewer Cleaning Machine

180. Get full details on the Sewer-Scooter for which sewage furnishes the operating power and which is operated entirely from street level. Bulletin on these time-saving machines available from Fitzgerald Engineering Co., Inc., P. O. Box 289, Coral Gables, 34, Fla., or by using coupon.

Data Offered On Mixed Flow Pumps

201. Data on the complete line of Worthington Mixflo pumps of the two-vane, non-clogging sewage type is offered in 16-page bulletin W-317-H16. Salient features are outlined, typical sections, performance curves and general data for five types are included. Helpful charts aid shafting selection. Copies available by using coupon or from Worthington Pump and Machinery Corp., Harrison, N. J.

Data on Design of Grit Collectors and Washers

202. Grit collection and separation of organic materials from settled grit is described in Link-Belt Bulletin 1942. Typical installations are shown, and design data is provided, together with specifications. Use coupon for copy, or write Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

How Vacuum Filters Help Your Sewage Sludge Disposal

209. Applications of the Conkey sludge filter to all types of sewage sludge are described in Bulletin 100. Tables show filter sizes, weights, and give anticipated average results. Use the coupon to order your copy. General American Transportation Corp., Process Equip. Div., New York 17, N. Y.

General Catalog on Measuring and Controlling Equipment

272. The full line of Simplex equipment for the measurement and control of liquids and gases in water and sewage plant installations is illustrated and described in detail in 28-page Catalog 002. Every engineer should study the design data in this helpful booklet. Write Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa., or use the coupon.

Complete Catalog for Engineers Shows Water and Sewage Plant Equipment

191. The complete line of Jeffrey equipment for treatment of water, sewage and industrial wastes is covered in 52-page Catalog 833. Detailed information is provided on bar screens, grinders, grit collectors, "Jigrit" washers, sludge collectors, feeders, conveyors and other related units. Photos and drawings of installations plus capacity tables complete this valuable booklet. Use coupon or write Jeffrey Mfg. Co., 947 N. 4th St., Columbus 16, Ohio.

How to Dispose of Sewage and Industrial Sludges

281. Get full information on the C. E. Raymond System of combined incineration and sludge drying providing high temperature deodorizing for nuisance-free sludge disposal. Flexible layouts fit large and small communities. Use handy coupon or write Combustion Engineering-Superheater, Inc., Flash Dryer Div., 200 Madison Ave., New York 16, N. Y.

WATER WORKS

Is Your City Metered 100%

33. 100% metering as practiced by many cities requires accurate, dependable meters with interchangeable parts. Cut-away views of every part, capacity and size data are all included in handsome American-Niagara water meter booklet available from Buffalo Meter Co., 2920 Main St., Buffalo 14, N. Y.

Helpful Valve and Fittings Catalog for Engineers

42. A complete 44-page catalog covering the M and H line of water works and sewage disposal equipment and accessories is offered to help design engineers and contractors who specify valves, hydrants and fittings. Get Catalog 34 from M & H Valve & Fittings Co., Anniston, Ala. by using the handy coupon.

All Electric Floatless Liquid Level Control

78. Description of operating principles and applications of B/W controls shows the simplicity and many uses of these all-electric, floatless devices. Diagrams of typical installations and engineering data all in bulletin 147 issued by B/W Controller Corp., Dept. PW. 2224 E. Maple Rd. Birmingham, Mich.

Factors to Consider in Elevated Tank Selection

88. An interesting discussion of the factors to be considered for selection of elevated capacities and sizes, required fire flows and other useful data are included in a bulletin on elevated water storage published by Pittsburgh-Des Moines Steel Co., Neville Island P. O., Pittsburgh 25, Pa.

Cement Lining for Smaller Diameter Water Lines

89. Water lines from 4" to 12" diameter are now cement-lined in place by Centriline Corp., using the Tate process. Catalog C-50 tells how this operation gives new pipe performance to old lines, and shows just how the work is done. An interesting folder, well worth studying. Check coupon for your copy. Centriline Corp., 140 Cedar St., New York 6, N. Y.

Engineering Data on The Permutit Precipitator

91. The Precipitator removes impurities from water by precipitation, adsorption, settling and upward filtration; requires less space, less chemicals, less time than any previous design of reaction and settling tank. Data on operating principles, recommended sizes, design details and specifications are included in 20-page illustrated bulletin No. 2204A. The Permutit Company, Dept. PW9, 330 West 42nd St., New York 18, N. Y. Use the coupon for your copy.

Rehabilitation for Your Water System

133. Whether your water supply system requires a complete rehabilitation program including an engineering survey, hydraulic analysis, reconditioning and related construction, or merely pipe cleaning and coating, it is wise to plan your campaign without delay. Get full data now on the requirements to put your system in top condition. Write Pittsburgh Pipe Cleaner Co., 133 Dahlem St., Pittsburgh 6, Pa., or check handy coupon.

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Pressure Pipe That Retains Capacity

106. Several bulletins describing the construction of pressure pipe, list of installations, carrying capacity tests, making service connections under pressure; and detail descriptions of several installations. Lock Joint Pipe Co., Box 269, East Orange, N. J.

Specs for Gate Valves

112. Rigidly inspected gate valves for pressures up to 175 lbs. by R. D. Wood Co. Sizes 2" to 30"; for any standard type joint. R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa.

Precise pH Control And Water Tests

117. A new 12-page catalog No. 600-10 illustrates and describes the Hellige Colorimetric Comparator line equipped with Non-Fading Glass Color Standards. The catalog also introduces the Hellige Daylite Comparator Illuminator for determinations in both artificial and day light. Write to Hellige, Inc., Dept. PW, 3718 Northern Blvd., Long Island City 1, N. Y., or use coupon.

What You Should Know About Fluoridation and Fluoridators

155. Two helpful publications issued by Wallace & Tiernan titled "Fluoridation" and "Fluoridators" show the development of fluoridation, list the chemicals and dosages normally used, and give full technical data on solution feed and dry feed fluoridators. Be sure to get these publications from Wallace & Tiernan by checking the coupon today.

Helpful Book Gives Pipe Flow

159. This handy 40-page pocket size book titled "Measurement of Water Flow Through Pipe Orifice with Free Discharge" explains the Layne pipe orifice meter method of computing water flow. Includes flow graphs for various size pipes. Layne & Bowler, Inc., Box 215, Hollywood Station, Memphis 8, Tenn.

Pipe Joint Essentials and Couplings for Every Job

168. Superior pipe joints are tight, flexible, simple, strong and economical. Dresser's handsome 34-page bulletin No. 513 shows how these essentials are met and provides layouts for curves, working pressures and a wealth of other data. Be sure to check this bulletin on the coupon. Dresser Mfg. Div., 59 Fisher Ave., Bradford, Pa.

How to Design Chemical Feed Systems

179. In a 12-page booklet published by Proportioneers, the many factors which enter into the design of a chemical feed system are discussed, and the types of systems used described in detail. These include dry feed, both volumetric and gravimetric and solution feed of the decanter and positive displacement pump types. Feeder controls are considered in detail. Send now for File No. RP-9080 by checking coupon. Proportioneers, Inc., Providence 1, R. I.

Sealed Repair for Broken Mains

203. Damaged water mains can be quickly and permanently repaired with Skinner-Seal split coupling clamps. Special gasket and clamp design withstands full fire-fighting pressure. For 2" to 16" pipe. Get details on this and other clamps from M. B. Skinner Co., Dept. PW, So. Bend 20, Ind. Check coupon now.

Investigate This Compact Flow Meter for Water

226. The Foster "Flow Tube" is a new metering element that is compact and easy to install. Bulletin FT illustrates simple element containing nozzles for differential pressure production and shows capacity range and accuracy. Made in standard type sizes. Foster Engineering Co., Union, N. J. will send copy, or use coupon.

Automatic Pump Control For Your Water System

239. In Bulletin 230-G4, Builders-Providence outlines the "Pressureflo Control" system which is said to save on first cost by providing ground level storage in residential areas; permit unattended operation of outlying stations; furnish instantaneous response to meet fire flow. Flow diagrams and typical applications are included. Mail coupon to check this versatile system. Builders-Providence, Inc., Providence 1, R. I.

Engineering Data On Mechanical Joint C.I. Pipe

183. General specification, weights and dimensions of mechanical joint cast iron pipe and fittings are furnished in a 32-page booklet issued by Alabama Pipe Co., Anniston, Ala. Get this helpful data by checking coupon.

Design Data for Hardness, Turbidity, Color or Algae Removal

253. Bulletin No. 9041 published by The Dorr Co. furnishes design data on the Hydro-Treator for high-rate, upflow type treatment of municipal and industrial water supplies. 32 pages include distinguishing features of the unit, types and sizes, capacity ratings and typical operating results. Get your copy of this helpful bulletin by using coupon today. The Dorr Co., Barry Pl., Stamford, Conn.

How to Compute Quantities of Jointing Materials

271. A helpful table for determining quantities of "Tegul-Mineralead" required, using jute or 'Hyde-Ro Rings", plus complete answers to your questions on sulfur compound jointing materials will be found in Bulletin M-10 issued by Atlas Mineral Products Co., Mertztown, Pa. Check the handy coupon today.

Standard Specifications for C. I. Pipe and Fittings

278. Standard dimensions for cast iron water pipe and special castings are available in a convenient booklet offered with the compliments of U. S. Pipe and Foundry Co., Burlington, N. J. Get your copy by checking the coupon.

PEST CONTROL

Chemicals for All Pest Control Work

199. Full data on dosages and methods of application of DDT, 2,4-D, BHC and other insect, weed and rodent control chemicals is available from Chemical Insecticide Co., 57 13th St., Brooklyn 15, N. Y.

REFUSE COLLECTION AND DISPOSAL

20 Questions and Answers On Sanitary Landfill

75. The advantages of sanitary landfill, factors in site selection, kind and size of equipment needed, capacity of a given site and other important engineering considerations are discussed in Form 1084 prepared by the Tracksen Co., Dept. PW101, Milwaukee 1, Wis. Check the coupon for complete information on this refuse disposal method.

Designing Septic Tanks For Garbage Disposal Units

97. The design of septic tank systems for use with the Waste-Away Garbage Disposer is covered in detail in Westinghouse Form 6SE-9913-2. Minimum tank allowances; applying Waste-Away to existing tanks; drainage fields and operation are some of the headings. Get your copy by checking the coupon. Westinghouse Electric Corp., Electric Appliance Div., Mansfield, Ohio.

Investigate This Plan For Garbage Elimination

164. A new presentation, written especially for municipal officials, offers a modern solution for the garbage disposal problem. Be sure you have this up-to-date information on the elimination of city garbage collection by the use of Hotpoint Disposall units. Check the coupon now. Hotpoint Disposall Department, 5600 West Taylor St., Chicago 44, Ill.

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Dempster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Dempster Brothers, Inc., 991 Dempster Bldg., Knoxville 17, Tenn., or use the handy coupon.

Seven Advantages of Sanitary Land Fills

171. Development of sanitary fills to lower sanitation costs and steps for the proper operation of these fills are described in bulletin 12314 titled "Lowering Health and Sanitation Costs" and issued by Caterpillar Tractor Co., Peoria 8, Ill.

For Speedy, Nuisance-Free Refuse Collection

190. The "Roto-Pac" provides automatic and continuous loading of all types of refuse, gives high compaction and low operating costs. Can be used for snow hauling. Get full information from City Tank Corp., 53-09 97th Pl., Corona 68, L. I., N. Y. Check the coupon today.

An Incinerator Necessity

215. Recuperators featuring individual replacement of the heat transfer elements (silicon carbide tubes) for maximum accessibility and efficiency are described and illustrated in Bulletin 14 issued by Fitch Recuperator Co., Dept. PW, Plainfield Nat'l Bank Bldg., Plainfield, N. J.

City-Wide Planning for Dual Waste Disposal

243. You can get full details on the General Electric "Disposall" plan for garbage elimination by converting food wastes to sewage. Learn how Jasper, Ind., eliminated garbage cans and collection nuisance with electrical disposal units by checking handy coupon. General Electric Co., Bridgeport 2, Conn.

STREETS AND HIGHWAYS

How the Mobil-Sweeper Can Improve Street Sweeping

23. Sweeping costs can be cut with the new Mobil-Sweeper which features safe highway speeds up to 55 mph, carries 2 2/3 cu. yd. dirt hopper, sweeps swath up to 10' wide with full floating brooms. Hills and deep gutters are no obstacle. Write to The Conveyor Co., 3260 E. Slauson Ave., Los Angeles 58, Calif. or use coupon for complete details on this machine.

Levels Sidewalks and Curbs Quickly and Easily

29. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 W. Concordia Ave., Milwaukee 10, Wis.

Get Data Now On This Catch Basin Cleaner

34. Simple powerful pneumatic bucket is featured by Netco Catch Basin Cleaner. Folder 33A gives details and illustrates operation of complete self powered truck mounted unit. Netco Div., Clark-Wilcox Co., 118 Western Ave., Boston 34, Mass.

Do You Have Complete Black Top Equipment Data?

41. In 36-page catalog AA a full line of equipment for black top road construction and maintenance is covered. Units described and illustrated include several models of pressure distributors, supply tanks, sprayers, brooms, asphalt kettles, portable rollers, and accessory tools. Use coupon for copy of this handy manual. Littleford Bros., 452 E. Pearl St., Cincinnati 2, Ohio.

End Dangerous Ice Hazards

111. Ice prevention on highways, streets and airport runways from Sterling "Auger Action" Rock Salt is described in bulletins from International Salt Co., Scranton, Pa. Check the coupon for your copies.

Reference Manual on Guardrail Design

114. Here is an interesting and informative booklet in which all factors influencing guardrail design are outlined, and safety and economy discussed in detail. Eight pages are devoted to basic design data, with handy tables covering physical properties, tensile and beam strengths, deflection and other data. Write Armco Drainage and Metal Products, Inc., Dept. PW, Middletown, Ohio.

Eliminate Hazard of Loose Gravel on Roads

125. Accidents caused by loose gravel can be checked and costly gravel loss reduced by proper stabilization of your gravel roads. Investigate the low-cost stabilization and gravel salvage methods offered by the Seaman Pulvi-Mixer. Bulletin "Stabilize Gravel Roads" is well worth studying. Check the coupon today. Seaman Motors, Inc., 305 N. 25th St., Milwaukee 3, Wisc.

Uniform Salt Spreading Saves Material

145. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on this spreader and table of material application rates. Use coupon or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

How You Can Improve Your City's Street Cleaning

162. The Austin-Western Model 40 sweeper features three wheel design, front wheel steer, for easy maneuvering; rear broom to sweep dirt and refuse directly into 2-yd. hopper; built-in flushing device. Diagrams showing all operations and full specifications in Bulletin AD-2042, issued by Austin-Western Co., Aurora, Ill.

Chemical Stops Salt Corrosion

174. A new chemical has been developed which, when mixed 1 pound to 100 pounds of salt, prevents any corrosion of automobiles by the salt. Harmless; colorless; odorless. Permits free use of salt for ice and snow control without complaint by drivers. Calgon, Inc., Pittsburgh, Pa.

Clears Out the Snow In a Hurry

208. The husky Sicard "Snow Master Junior" is a low cost machine with big performance for loading snow on trucks or casting it to vacant areas. Wrist-action chute controls direction and angle of discharge. Get full data from Sicard Industries, Inc., 753 W. Main St., Watertown, N. Y. by using the coupon.

1. What ?? were speed demons in Nero's day?
2. What ?? drive slow freight through mountain country?
3. What ?? make quick work of wet roads in Venice?
4. What ?? will help you feed chemicals at speeds to suit water flow rates?
Answer:
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If your water flows are likely to vary from a mule's pace to express rates, chances are you need %Proportioneers% Automatic and Proportional Chem-O-Feeder. This system is 100% hydraulically operated . . . requires no electricity or other power supply. With it you can feed hypochlorites at rates from 0-5 g.p.h., pressures from 10 to 125 psi. in strict proportion to the flow through the pipeline.

This is just one of the many types of water treating and purifying systems which %Proportioneers, Inc.% offers you. Mail coupon or write today for data and recommendations.

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Please send Bulletins describing % Proportioneers % Flow-Proportional water treating equipment.

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Answers: (1) Charioteers (2) Muleteers (3) Gondoleers
4. % PROPORTIONEERS, INC. %

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A TURBIDIMETER WITHOUT STA-RITE

ACCURATE
FOOLPROOF
VERSATILE

FOR TURBIDITY MEASUREMENTS, SULFATE DETERMINATIONS, AND SPECIAL APPLICATIONS

Modern in design and operating principle, the Hellige Turbidimeter does not require standard suspensions or long cumbersome tubes. Accurate readings can be made rapidly by those without technical training.

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CATALOG No. 8000-A

HELLIGE *Inc.*

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Automatic EMERGENCY LIGHTS
GO ON *Instantly*

For:
Government, Military and Civilian Institutions, Office Buildings, and Bomb Shelters

BIG BEAM
Model No. 2-AD SPECIAL

In panic, disaster, air raids, or whenever a failure occurs in your regular lighting service Big Beam Emergency Lights will give instant, automatic light. Two 6-inch floodlights, operating on a 9-volt standard dry battery give powerful light over a wide area.

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CUT MAINTENANCE COSTS with Dixon *time-proved* primers and paints . . . Provides *maximum* long-life and painting economy. Superior for all kinds of *outdoor metal surfaces.*

HELPFUL LITERATURE

• Water Tank Painting Bulletin • Contract Forms and Specifications for Water Tank Painting • "How to Paint a Bridge." • "What You Should Know About Painting Water Tanks."

Write: Joseph Dixon Crucible Co., Paint Division, Jersey City 3, N. J.

DIXON
FLAKE SILICA GRAPHITE
PAINTS
Specialists in Protective paints — for almost a century

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Air Cooled Engines for Hundreds of Applications

137. Tested under severest conditions of long, hard use, these engines have earned world wide recognition as the "right" power for hundreds of applications. Get latest bulletin from Dept. PW, Briggs and Stratton Corp., Milwaukee 1, Wisc.

Protection Against Power Failure

169. Data on stationary, portable, and standby electric plants, AC and DC, are offered by D. W. Onan & Sons, Inc., 7654 University Ave., Minneapolis 5, Minn. Several bulletins cover diesel and gasoline-driven plants for every purpose. Just check the coupon for your copies.

Electric Equipment For Rescue Work

185. Homelite Carryable gasoline-engine-driven generators will supply light in all emergencies and plenty of power to operate the self-priming pumps, blowers and chain saws used by rescue teams. Get full data on these units by checking coupon or write Homelite, Inc., Dept. PW, 2108 Riverdale Ave., Port Chester, N. Y.

Emergency Chlorination and Main Sterilization

213. Get data on portable emergency chlorination units designed to save time in cases of broken mains or substitute water supplies. Use coupon to order copies of publications 22-C; 58-C; and 408 from Wallace & Tiernan Co., Newark 1, N. J.

Technical Consulting Service On 2-Way Radio Systems

218. Civil Defense communications by mobile 2-way radio are a vital part of your plans. Helpful technical consulting service is offered by Motorola, C & E Div., 4545 Augusta Blvd., Chicago 51, Ill. Check the coupon now.

Be Ready to Bridge Gaps and Holes

244. Rugged open grid steel grating sections can bridge holes, serve as ramps, keep traffic moving over mud and rubble. Get catalog today from Irving Subway Grating Co., Inc., 50-53 27th St., Long Island City 1, N. Y., by using coupon.

CONSTRUCTION EQUIPMENT AND MATERIALS

Your Dump Truck As a Complete Working Unit

39. The addition of a Holmes-Owen Loader to your dump truck converts it into a complete digging and loading unit that enables one man to load, haul and dump. Illustrated folder shows how this self-loading unit with hydraulic crowding action can be a real time and labor saver for the municipality or contractor. Check the handy coupon for full data. Ernest Holmes Co., Chattanooga, Tenn.

Handbook of Contractors Pumps Is Easy to Use

49. Big 50-page Catalog P-10 covers dewatering pumps, pressure pumps, well points systems and electric pumps, and also features a special section of useful data which helps in the selection of the right pump for your job. Every construction engineer and contractor should have a copy of this valuable handbook. Just check the coupon. The Jaeger Machine Co., 400 Dublin Ave., Columbus 16, Ohio.

How to Keep Your Loader On the Job

50. Don't take more time to move your loader to the job than to do the work. Investigate the Eagle Truck Mounted Loader for handling gravel, sand, cinders, snow from windrows or piles. Get forms 444 and 947 from Eagle Crusher Co., Inc., Dept. PW, Galion, Ohio.

Check Your Power Needs Without Delay

68. International Harvester Company has available a new folder describing its line of

diesel engines and power units for all your power needs up to 180 hp. For a copy of this colorful booklet, write to International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., and ask for Form A-256-NN, or use the handy coupon and we will forward your request.

Handy Catalog Covers Complete Tractor and Grader Line

70. A new 20-page booklet in a handy pocket size features Allis-Chalmers complete industrial tractor line. The importance of wise buying and fitting the equipment to the job is emphasized. Don't miss your copy. Use coupon today. Allis-Chalmers Mfg. Co., Tractor Div., Box 512, Milwaukee, Wis.

Safety Lantern With Pencil Beam Signal

77. Get information on the Dietz "Night Watch" Safety Lanlern with special globe design that saves fuel by intensifying light rays into a pencil beam. Full details available from R. E. Dietz Co., Syracuse, N. Y. Just check the handy coupon.

Drill Concrete With Your Ordinary Electric Drill

82. Substantial cost-per-hole savings are claimed for Tilden Rotary Drills which penetrate concrete 2" to 4" per minute. Cutters can be resharpened. Available in sizes ¼" to 4". Get full data from Tilden Tool Mfg. Co., 209 Los Molinos, San Clemente, Calif.

Modern Convenience for Soldering and Melting Metals

85. Insto-Gas torches and furnaces give trouble-free service for lead melting, soldering, all other jobs where a steady, clean, hot flame is needed. Convenient cylinders require no regulating gauges, attach directly to standard furnace assembly. Get Form 222 for full details by checking handy coupon. Insto-Gas Corp., Detroit 7, Mich.

Bucket Loaders for All Materials Handling

132. Wheel- or crawler-mounted bucket loaders, 3 to 4 cyrn capacities are described in Form 501 issued by N. P. Nelson Iron Works, Inc., Clifton, N. J. Use the coupon today for full data on these versatile machines.

How to Save Time on Curb and Gutter Work

143. Every type of curb and gutter work is illustrated in the 12-page Heltzel catalog on steel forms for building concrete curbs, gutters and sidewalks. Time-saving setups show how to speed up the job and save money. Get your copy from Heltzel Steel Form & Iron Co., Dept., PW, Warren, Ohio.

Versatile Maintainer Has Year 'Round Usefulness

151. A new bulletin shows how the sturdy Huber Maintainer will work for you the year 'round on maintenance jobs, berm leveling, road planing, bull-dozing, snow plowing, brooming, mowing shoulders and as a patch roller. Good ideas on how to do all these jobs in Bulletin No. M-138. Write Huber Manufacturing Co., Dept. PW, Marion, Ohio.

Tractor-Mounted Backhoe Simplifies Digging Operations

238. Be sure to investigate the new Henry Backhoe to cut digging costs on laterals, footinga, septic tanks, graves. Easily attached to your tractor. Get full data from Henry Mfg. Co., 1712 N. Clay St., Topeka, Kansas, by using couopn.

Full Line of Plows Meets All Snow Removal Needs

242. Data issued by the Gledhill Co. covers the 22 standard snow plows available to meet all snow removal needs. Safety trip, foldback hoist and interchangeability are featured. Write Gledhill Road Machinery Co., Galion, Ohio, or use coupon.

Gunite Costs Less On Repair Jobs

255. Be sure to investigate Gunite for repair of reservoirs, dams, water and sewage plant tanks, sewers, swimming pools, etc. Contact Eastern Gunite Co., Elkins Park, Pa. for full information, or use coupon.

New Portable Roller Performs Many Jobs

60. An attractive four-color catalog No. 350 presenting their new portable roller is available from The Galion Iron Works and Mfg. Co., Galion, Ohio. Construction and operation features include: hydraulic steering, constant mesh transmission, spur gear final drive, variable weight compression roll and towing hitch with built-in hydraulic jack. Use the handy coupon for your copy.

Proper Garage Ventilation Aids Equipment Maintenance

156. Cold months hamper motor maintenance in closed buildings unless proper ventilation is available. It will pay you to investigate the "National" garage ventilation systems for conveninent removal of exhaust gases. Both underfloor and overhead designs are shown in detail in new bulletin. Use coupon or write to National Systems of Garage Ventilation, Inc. Dept. 16-F, 318 N. Church St., Decatur, Ill.

Combination Overhead And Front-End Shovel

194. The "Lodover", described in Bulletin LO 200, is a combination overhead and front-end shovel for International T-9 and TD-9 tractors. By digging in front, swinging load overhead and dumping to the rear, extra yards are handled every hour. Regular front-end loading is not impeded in any way. Service Supply Corporation, 2004 Erie Ave., Philadelphia 32, Pa. Check handy coupon.

Versatile Wheeled Tractor Handles Countless Jobs

294. A new booklet on industrial wheeled tractors recently published by The Oliver Corp. covers the complete Oliver line. Many application photos show use of tractors with matched allied equipment such as bucket loaders, maintainers, plows, mowers, brooms, etc. Get this bulletin, Form A-918, from The Oliver Corp., 19300 Euclid Ave., Cleveland 17, Ohio.

Because a cement lining can be thin, yet structurally sound, and because cement prohibits corrosion, the flow capacities of Centrilined pipes are often greater than when the pipes were new! . . . The smooth cement surface reduces pumping costs and seals holes caused by external and internal corrosion . . . The Centriline process, which mechanically applies cement by centrifugal force, then trowels the surface smooth, gives your pipe lines a new lease on life . . . at a fraction of the cost of laying new pipes.

Write us today for descriptive literature on lining pipes from 4" to 144" in diameter

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CEMENT MORTAR LININGS FOR PIPE IN PLACE

ON THE WEST COAST, WRITE AMERICAN PIPE & CONSTRUCTION CO., P.O. BOX 3428, TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

AUTOMATIC
Sewage Regulators

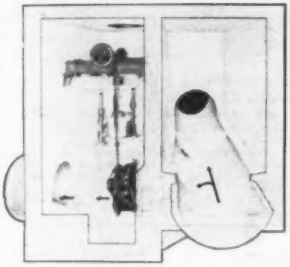


Fig.8-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

TIDE GATES

Fig. B-68 Type M (Circular)

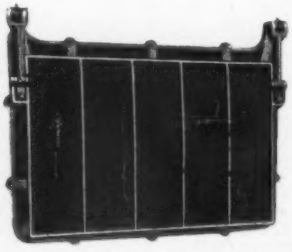


Fig. B-61 Type M-M (Rectangular)

Brown & Brown, Inc.
Lima, Ohio

WORTH TELLING . . .

by Arthur K. Akers

★ We went up to Syracuse, N. Y. in September to attend what the **General Electric Company** predicted as "one of the most important conferences in its history." It proved just that. The two-day meeting was high-lighted by a preview and the first demonstration of the Onondaga County civil defense emergency communications network, a press dinner, and some elbow rubbing (we did not say **lifting**) with various governors, mayors of large cities, and national civil defense and military authorities from Washington. All smoothly and expertly handled in true G. E. style.

★ Again two young men move up at **Builders-Providence. Richard L. Lauderdale** goes to **Builders-Pacific** at Berkeley, Calif.; and **Walter H. Brown** to the Proj-

Mr. Lauderdale

Mr. Brown

ects Department in Providence, specializing in equipment applications for sewage and industrial wastes treatment. He was formerly superintendent of the Cranston, R. I. sewage treatment plant.

★ **Carl Lassen** has moved from **Worthington Pump and Machinery Corporation** to **Wallace and Tiernan** advertising department, as a special assistant.

★ Here is the new San Francisco building of **De Laval Steam Turbine Company**, of Trenton, N. J. It will house their sales and service activities, under **C. F. Reeves**, long in charge of their West Coast sales.

Mr. Hopp

★ **F. A. Hopp**, formerly with **Rockwell Manufacturing Company**, is now advertising manager of the **Cleaver - Brooks Company**, Milwaukee 12, Wis.

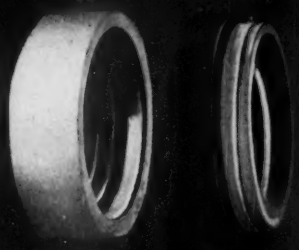
★ **Graver Water Conditioning Company**, New York, announces appointment of **Harold R. Fosnot** as eastern sales manager, at its New York home office. Replacing him as Chicago district manager will be **Herman M. Ross**, and succeeding Mr. Ross at Cleveland will be **Richard E. Lewis.**

★ **William H. Schuelie**, export representative for **Littleford Brothers**, Cincinnati, has just returned from a four months trip through fifteen countries in Europe, lecturing and showing movies on U. S. equipment and methods in building low cost bituminous roads.

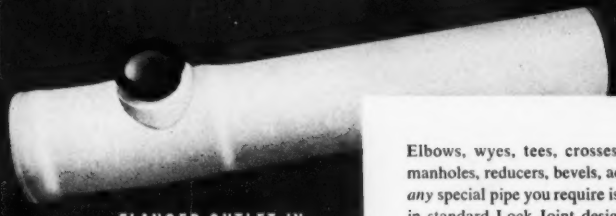
★ We couldn't operate this column some months without **Jack Service's Sparling Meter** METROGRAMS to borrow a good laugh from. This time, "It's all in the way you say it! Instead of 'His old man died on the hot seat,' how much better to say 'His father occupied the chair of applied electricity in one of our well known state institutions.' "

De Laval's new home in San Francisco

"Specials" are a Specialty of LOCK JOINT...



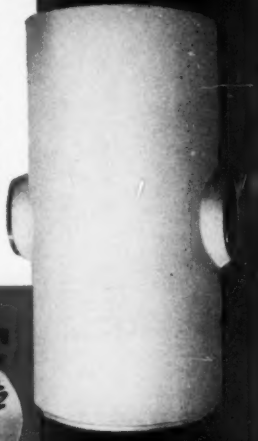
ADAPTORS—
LOCK JOINT TO
CAST IRON PIPE



FLANGED OUTLET IN
FULL LENGTH PIPE

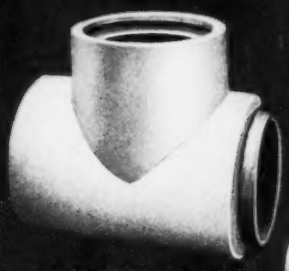
Elbows, wyes, tees, crosses, outlets, manholes, reducers, bevels, adaptors... *any* special pipe you require is available in standard Lock Joint design. And if standard specials won't do the job, "special" specials may be designed to individual specifications. Lock Joint Concrete Pressure Pipe can be connected swiftly and efficiently to any standard water pipe of other material. All specials are engineered with the same care and high safety factor that have made Lock Joint the pipe of unexcelled durability and dependability.

LOCK JOINT 90° ELBOW



CROSS IN FULL
LENGTH PIPE

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE



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LOCK JOINT PIPE COMPANY

Est. 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich.

BRANCH OFFICES: Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. Kansas City, Mo. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. Wichita, Kan. • Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. Oklahoma City, Okla. • Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

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Chlorination—the modern aid to sewage treatment—has proven its ability to overcome many sewage treatment "headaches" in hundreds of plants all over the country.

To mention only a few—chlorination *controls odors* at Fort Wayne, Indiana; *reduces filter ponding* at Rotterdam, New York; and *sterilizes the effluent* of the Easterly Sewage Plant in Cleveland, Ohio.

Results? Here's a typical statement from Mr. Ralph Hoot, Superintendent at Fort Wayne. "***We have been most thankful for our automatic chlorine control equipment. It has done its job well."

Chlorination engineered by Wallace & Tiernan can help *your* plant, too. Best of all the cost generally averages less than 1% of initial plant investment. This low cost, coupled with the savings and increased plant efficiency made possible by effective chlorination, makes it a buy dollar-wise purchasers can't afford to overlook.

Put this modern aid to sewage treatment to work in *your* plant. A call to your nearest Wallace & Tiernan Representative brings all the details.

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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
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